The Electrical Industry's Weekly Magazine September 12, 1960

Electrical World

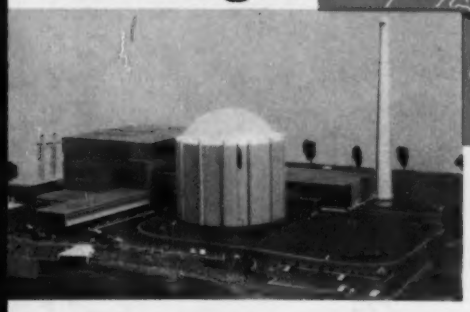
Price 50 Cents

A McGraw-Hill Publication

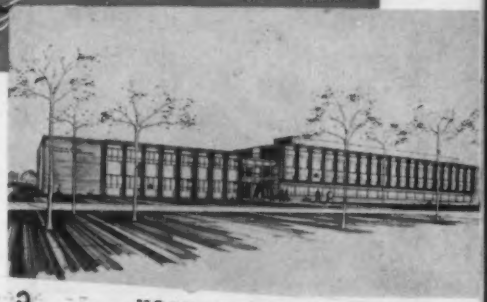
Canadian Utilities Plan Big Expansion...

...at Montreal

...at Douglas Point



...at Toronto



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WHAT BROUGHT TROUBLE TO EQUIPMENT MARKET
Second in a series of three articles . . . page 89

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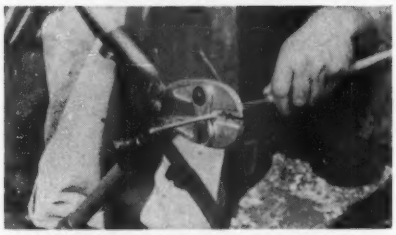
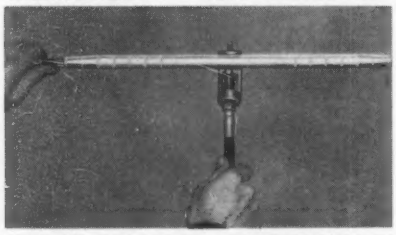
5 STEP 2-PIECE SPLICING

1. Aluminum strands must be carefully stripped back to the correct length. Care must be taken not to nick steel core.

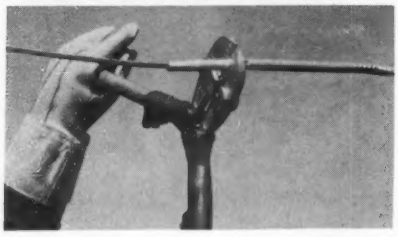
2. Position of aluminum sleeve is marked on cable to facilitate subsequent centering over steel core. Lineman must then remember to slip aluminum sleeve onto conductor.



3. Steel sleeve is then crimped onto steel core.



4. Aluminum sleeve is properly centered over steel core. PENETROX is pumped into aluminum sleeve thru filler hole.



5. Aluminum sleeve is finally crimped onto cable.

2-STEP UNISPLICING

1. Cables are inserted into one piece aluminum UNISPLICE. No stripping, no marking or centering required.

2. Install UNISPLICE using BURNDY MD5-3 Hytool or Y35 Hypress. UNISPLICE is factory filled with PENETROX.®

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BURNDY

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58-5

Electrical World

Vol. 154, No. 11 SEPTEMBER 12, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electrical power

In This Week's Issue

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PASNY Sets Preliminary Niagara Rates

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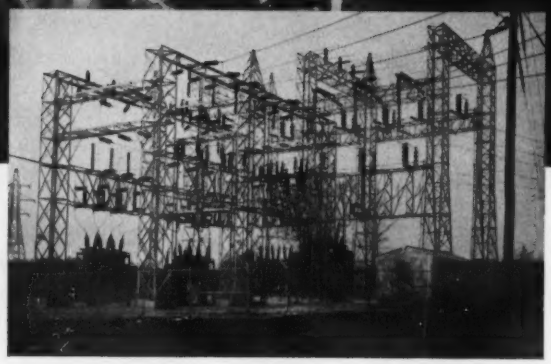

CARL SHOLAR AND KEN WEST of Kentucky Utilities, who supervised installation of all cables at the new Walker Substation, examine terminations of some of the Okonite control cable in the station. In the foreground, Mr. Sholar points to Okolite-Okoprene aerial cable which goes to the Earlington Substation.

Cable'bility at work

Kentucky Utilities chooses Okonite control cable on basis of performance record

Cable'bility (cā'ble·bil'·i·ty) *new word.* *Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

Kentucky Utilities chose Okonite control cable for its new 161 to 69 kv substation one-half mile west of Earlington, Kentucky, and used it in many ways . . . underground in ducts, in conduit and aerially on a messenger.

Okonite's service record in other Kentucky Utilities installations was the prime factor in specification of the control cable for Walker Substation. Time after time, in recent years, the utility has purchased Okonite control cable because of satisfaction with its performance.

Another important factor to Kentucky Utilities was that Okonite manufactured the cable with colored neoprene on each conductor for easy coding. (Included in the installation at Walker are Okolite-Okoprene aerial control cables, Watertite-Okoprene control cables and Okoseal 200 PVC insulated switchboard cable.)

Okonite can help *you*, too, in meeting the exact requirements of your job, from manufacture through installation. To help you specify the best cable for your important power and control needs, contact your Okonite representative or write for Bulletin EW-1117, "How To Choose Insulated Cable." The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

***where there's electrical power . . . there's* OKONITE CABLE**

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LETTERS

Mutual Understanding Is Needed

To the Editor:

Your editorial "They Can't Lose the Election," in the July 25 issue will do nothing to help "politicos" find that cooperatives and the commercial power companies are not "mortal enemies."

Here's why: You still refuse to recognize that it was never intended that the electric co-ops would compete with the commercial power companies in the past or in the future. The legislators who developed the REA Act, bringing dependable central station electric power to 90% of our rural areas directly and indirectly, clearly reflected the previous statement in the following ways: The REA Act specifically prohibited REA borrowers (co-ops, municipals, power companies alike) from (1) duplicating existing facilities, (2) going into towns over 1,500 population, and (3) providing their own generation and transmission unless stiff requirements were met.

More important, REA borrowers are required to serve everyone in the area without charge to the consumer (area coverage), whether or not they are a few feet or a few thousand feet from the lines. Also, most rural lines are exposed to the elements, over mountains and through woods, swamps, and cultivated fields, requiring a great deal more costly operation than urban lines with many consumers to a mile of line.

In recognition of the above circumstances, Congress said in effect to those interested in serving rural areas, commercial power companies included, "You serve everyone in your area under the restrictions outlined above and we will make low-cost financing available to you." This covenant not only covers original service, but is still available and needed to meet future requirements of existing and new customers.

You also need to recognize that as a general rule, electric co-ops are non-profit corporations and pay every tax that any other corporation pays, except a federal income tax. No individual or corporation pays an income tax if they have no profit. If an electric co-op has revenue in excess of expenses, it belongs to the member-consumers, not the cooperative. When it is paid to them in cash, they pay an income tax on it. Personally, I am opposed to the "double taxation" that profit corporations pay when their earnings are taxed as a corporation and again as dividends to the stockholders. But because it happens to them, don't try to impose it on our non-profit corporations.

Recognition of the fact that the REA program was born of necessity and that there are justifiable reasons for our low-cost financing and tax status would go a long way toward developing improved relations in the electric utility business between electric co-ops and commercial power companies.

It would also be a big help if the commercial

(*Continued on page* 99)

Government Finds Air Grows Dirtier Despite New Preventive Push

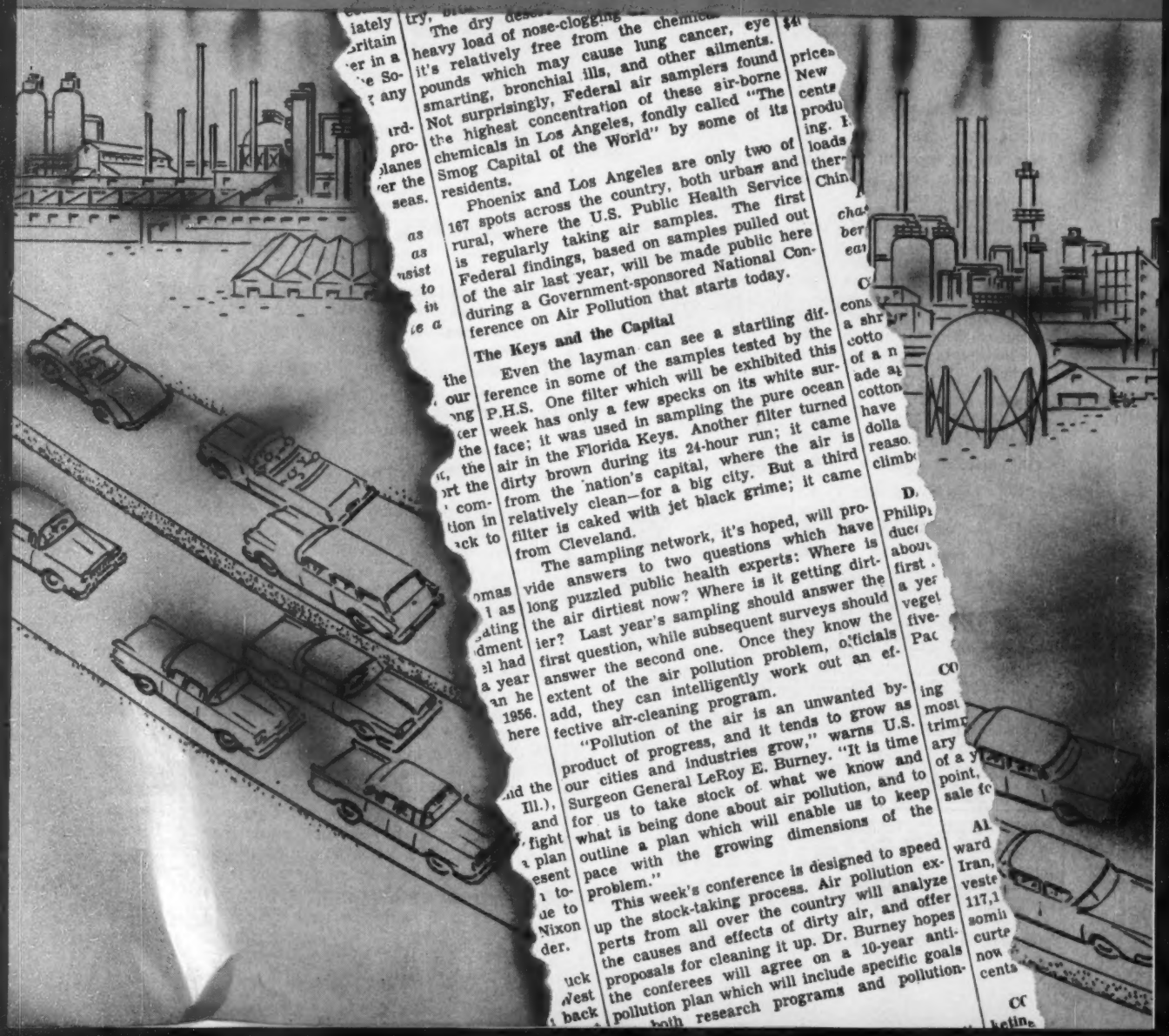
* * *

Los Angeles Leads in One Type Of Dirt, Phoenix in Another; Local Groups Confer Today

By James A. Reynolds
Staff Reporter of The Wall Street Journal

WASHINGTON—The Government is about to unveil the initial findings of the first systematic attempt to measure the scope and seriousness of a major national problem: Dirty air. A preliminary glance peek at the findings indicates the problem is indeed serious and

You can't get rid of atmospheric contamination...



Lapp introduced the "Fog-Type" insulator design 35 years ago to answer the demand for an effective means of overhead transmission under conditions of severe atmospheric contamination.

All evidence points to the fact that dirt conditions today are worse than ever before, and that there is no real relief in sight.

Realistic appraisal of the problem dictates the wisdom of ***handling*** dirt conditions, which, for outdoor distribution, transmission and station systems, means ***insulating*** for it.

..... Better insulate for it

Why has Lapp's 35-year concept of Fog-Type design remained the one constant in this much-misunderstood area of insulator behavior? Why have Lapp Fog-Type corrugations become the industry standard design for bushings, potheads and other critical outdoor use?

It is because Lapp Fog-Type design is based on the principle of avoiding leakage flashover by controlling leakage current flow. The extra length of leakage path is also a uniform leakage path. Dry, high-resistance, shielded areas of insulator surface are avoided; instead, there's a maximum exposure of surface to contamination . . . to wetting . . . and to cleaning action of wind and rain. Current flows evenly, voltage is distributed over the surface, leakage flashover is prevented.

Even in most areas of severe atmospheric contamination, Lapp Fog-Type insulators require no cleaning; where they do, cleaning intervals are longer, and cleaning is easier than on other types.

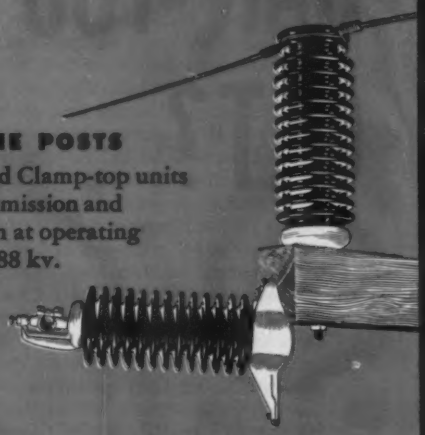
Forward utility thinking now calls for use of Fog-Type insulation on *all* systems in sea-shore or urban locations. It pays off in improved service and reduced maintenance costs.

"Fog-Type design" has been a provocative subject over the years. Lapp's viewpoint is explained, and substantiated, in the new Lapp Catalog No. 8. If you have not received a copy, ask for it.

Lapp Insulator Co., Inc.,
LeRoy, New York.

LAPP DISTRIBUTION FOG-TYPE INSULATORS

• Fog pin-types for voltages to 20 kv; Distribution Posts in three sizes for use up to 27 kv; Fog-Type distribution dead end insulators; Distribution switch Posts in four sizes to 150 BIL.



LAPP LINE POSTS

Tie-wire and Clamp-top units for subtransmission and transmission at operating voltages to 88 kv.

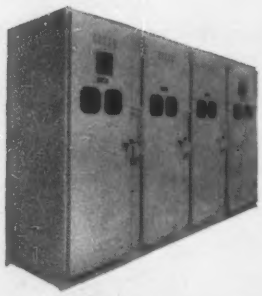
LAPP STATION POSTS

Superior electrical and mechanical characteristics for all switch and bus support at voltage ratings to 1,800 BIL.

SUSPENSION FOG-TYPES

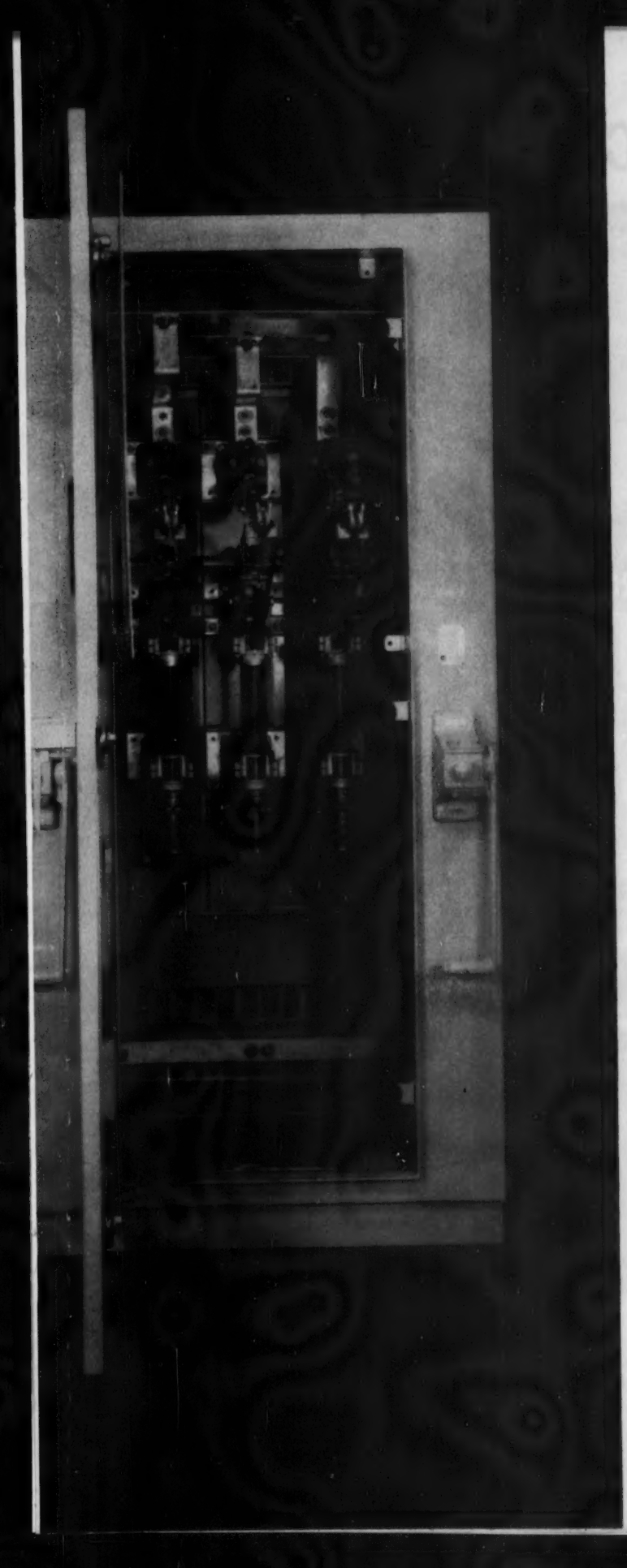
Standard strength (15,000-lb.) and high-strength (25,000-lb.) units for 5¾" or 6½" spacing, either ball-socket or clevis type.

HOW SIMPLE CAN YOU GET?



S&C metalclad switchgear meets all National Electric Code requirements for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.

FUSE REFILLS



S&C metalclad switchgear is easy to operate, easy to maintain, easy to understand

The simplicity of the fused interrupters in S&C metalclad switchgear means that everyone from the consulting engineer to the electrical contractor to the plant engineer and electrician saves time, money, and effort. The power fuses give positive and permanently accurate protection against faults. The load interrupters provide full load switching and can close on any fault up to 60,000 amps (at 4.16 kv). The power fuse in series with the load interrupter takes the mystery and high cost out of high-voltage switch-gear for industrial plants and for commercial and industrial buildings.

Costing roughly half the price of comparably rated circuit-breaker equipment, S&C metalclad switchgear protects high-voltage power supply circuits with self-sufficient power fuses. Permanent faults are detected without the complicated relay systems or instrument transformers required with circuit breakers. (Transient faults do not occur on industrial or commercial power supply circuits. Thus the expensive repetitive and automatic reclosing features of circuit breakers are not needed.) After the fault has been corrected, simply replace the blown fuse with a $13.50 refill stored right in the enclosure door.

Operating instructions and installation are simple with S&C metalclad switchgear. Nothing to set, adjust, exercise or check out. Plant personnel find it easy to understand and operate.

Why not consider S&C metalclad switchgear for your high-voltage (2300 to 15,000-volt) power systems? For more information, please consult the telephone directory for your nearest S&C sales office. Or write to:

S & C ELECTRIC COMPANY

4421 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911

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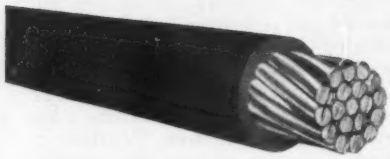
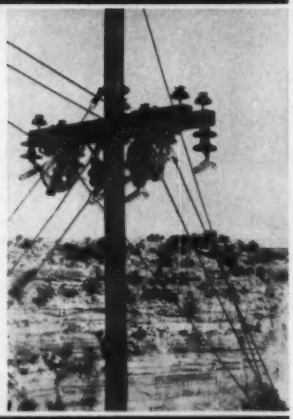
News about

B.F.Goodrich Chemical *raw materials*



75,000 ft of 101,800 CM, 12/7 ACSR cable with a 2/64th inch covering of Geon vinyl was supplied to Arizona Public Service Company by Kaiser Aluminum & Chemical Corporation. B.F.Goodrich Chemical Company supplies the Geon vinyl.



Helicopter handles stringing of ACSR insulated with Geon

Length of spans and difficulties of terrain created problems for Arizona Public Service Company in this 75,000-ft cable stringing job on the southern rim of Grand Canyon. The longest of the 20 spans is 3000 ft, with an elevation drop of 1800 ft.

With helicopter handling and other tough installation and operation problems, selection of Geon vinyl for insulation is a natural. Geon is tough. It withstands abrasion and provides the kind of resistance to weathering and heat that gives satisfactory service for severest operating conditions. Dielectric properties are excellent. Geon also provides another advantage: it was easy to color this insulation black to match the rock formations of the canyon wall.

Here's another example of the way that Geon vinyl solves product problems —reasons many manufacturers use Geon to improve products and open new markets. For more information, write Dept. GX-10, B.F.Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

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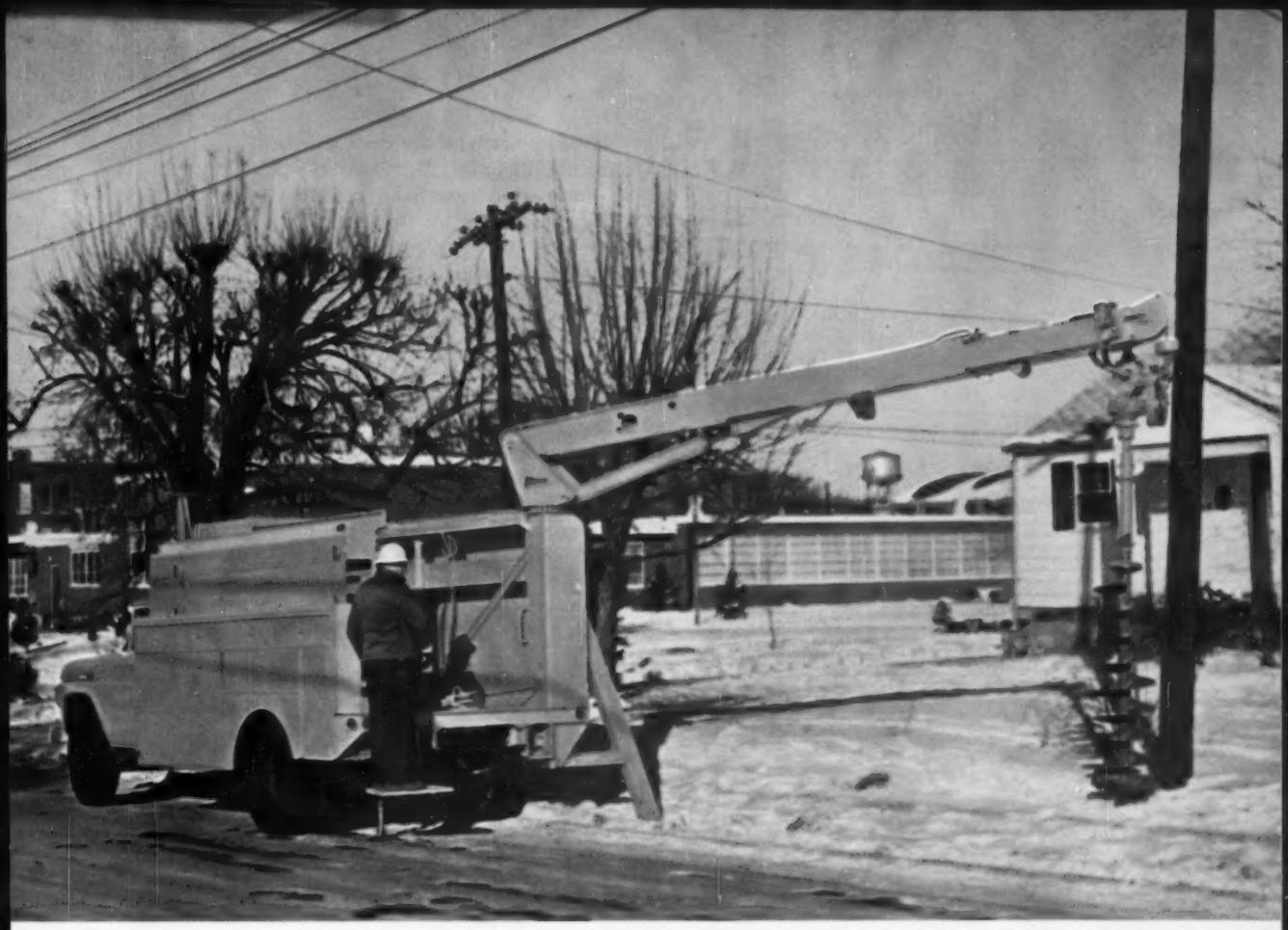


replace muscle with the new

PITMAN POLECAT™

...makes your operator a one-man gang!

Community demand is growing by leaps and bounds. Your expansion program will have to hustle to keep up with it—and the way to do this is *not* by adding costly muscle-power . . . but through a fleet of versatile Pitman Polecats!

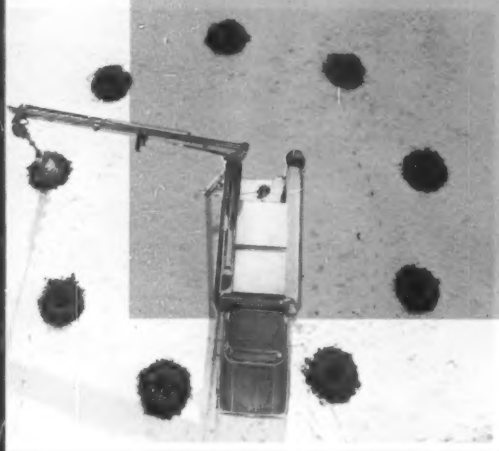
The all-hydraulic Polecat is much more than just another modified A-frame. It combines the functions of a digger, derrick *and* insulated crowsnest . . . does all three better than single-purpose units on the market. It makes best use of skilled men, eliminates more specialized vehicles; yet, with all its unique flexibility and performance, the Polecat is sensibly priced. It will quickly pay for itself—many times over—in increased crew efficiency.

This compact unit can be used with almost any utility line body, new or in-use. It can be center-mounted behind the cab, or installed in either rear corner, according to your individual requirements. Turn this page for more details . . .

the new

PITMAN POLECAT™

...changes its skills to match the job at hand!



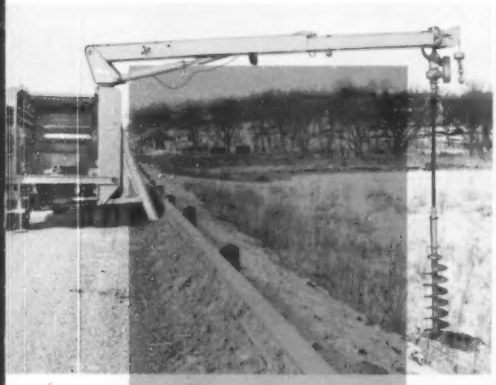
Digs all these holes from one truck position! Boom rotates 360° in either direction, digs holes in a circle from 24′ to 40′ in diameter. Digger head transfers instantly from basic boom to extendible tip simply by pulling and replacing a steel pin. Operator digs precisely, close to obstructions. Boom-tip inches in or out to keep hole straight. Same control digs holes for dead-end anchors, angling in any direction.

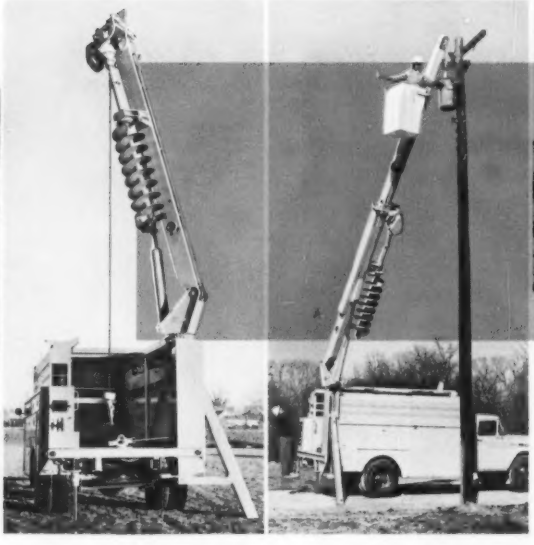
Auger hurdles walls, hedges, ditches, fences! With digger pinned to extended boom, Polecat reaches over guard rail to dig at foot of steep bank. Telescoping extension, built into digger shaft, permits full-depth holes far below road level. Hydraulic down-pressure sufficient to chew through frost, shale, hardpan.

Doubles as hydraulic derrick, loads its own truck bed! With digger stowed and pinned to basic boom, "stinger" can extend from 14′ to 22′ as a derrick. Reaches over obstructions to lift 8,000 lbs. Deck stays clear for materials.

Boom reaches 32 feet up, under full load, to lift replacement pole into position. Handles 40′ to 60′ poles easily. "Stinger" inches in or out to position heavy transformers on poles, too. Boom revolves, raises and extends simultaneously. Control panel in a choice of locations.

Fiberglass boom extension locks into extendible boom-tip, supports one or two fiberglass buckets for work on hot lines. Non-conductive rope runs over sheave in end of extension, lifts transformers up to 40′ above ground.





If you'd like to see this remarkable machine in action, your Pitman Distributor will be glad to oblige with a thorough demonstration. Or, simply contact . . .

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The Electrical Week

FUTURE NEWS ▶ **When official details of negotiations** between the US and Canada on development of the Columbia River are made public, they will probably show that British Columbia has won its battle for emphasis on High Arrow Dam. High Arrow and Mica Creek will be started at the same time but High Arrow will be finished first (see story on p 51).

LATE NEWS ▶ **Not all industries are satisfied** with rate proposals being offered by the Power Authority of the State of New York for Niagara Project power. Although PASNY has not said what the rates are, a group of Buffalo industrialists figure the low power factor rate is about 5 mills and the high power factor rate is about 4.2 mills. Most Niagara Falls industry is of high power factor nature while Buffalo industries fall into the low power factor category. An appeal by the Buffalo group is being considered (see story on p 50).

Kentucky is trying to become the first state to license private firms to handle certain nuclear materials under new authorization by the Atomic Energy Commission. It has notified AEC of readiness to deal.

Elijah B. Prettyman, Federal Appeals Court Judge, is appointed by Pres Eisenhower as chairman of "Conference on Administrative Procedure" to study means of improving procedures of federal regulatory agencies.

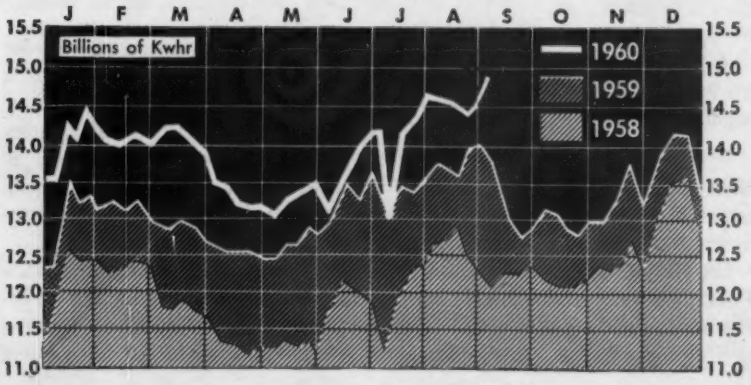
Strengthening Vermont's regulatory control over public utilities will require 29 measures to bring laws up to date, according to C. R. Ross, chairman of the state Public Service Commission. Proposals will be submitted to the 1961 legislature.

A strike against the Pennsylvania Railroad Co causes curtailed coal deliveries to the Delmarva Peninsula, which could result in power shortages. I-T-E Circuit Breaker Co reports no delay in shipments from Philadelphia.

Last of Senate Interior Subcommittee hearings in Alaska will be held Sept. 14-16 in Juneau. Proposed hydro power development is topic.

Weekly power output figures reached a new all-time high for the week ending Sept. 3. Total was 14,941,000,000 kwhr, compared to 14,746,000,000 kwhr for the week ending July 30.

WEEKLY POWER OUTPUT—Up 8.6% (Week ending Sept. 3), Kwhr 14,941,000,000



Per Cent Change From Previous Year

	Aug. 20	Aug. 27	Sept. 3
Total U. S.	+ 3.2	+ 3.5	+ 8.6
New Eng.	− 0.3	+ 2.3	+ 3.2
Mid. Atlan.	− 3.8	− 0.4	+ 3.5
Cent. Ind.	+ 3.1	+ 1.5	+12.6
West Cent.	+ 1.3	+ 0.8	+15.3
Southeast	+ 3.7	+ 0.7	+ 6.7
South Cent.	+ 1.5	+12.0	+ 6.5
Rocky Mount	+15.3	+15.1	+11.8
Pacific			
NW	+ 5.7	+ 9.0	+11.0
SW	+14.2	+ 8.0	+ 9.5

Seasonally Adjusted Index 274.3

Week Ago 268.9 Year Ago 261.3

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **The Power Authority of the State of New York starts negotiations** for allocations of power and rates to be charged **(p 50)** . . . Mexican Power & Light Co sale to government is confirmed **(p 51)** . . . Agreement between US and Canada on development of Columbia River is near **(p 51)** . . . Nez Perce and High Mountain Sheep proposals introduced to FPC **(p 52).**

ENGINEERING ▶ **Big hydro projects, higher transmission** voltage, coast-to-coast interconnections and a drive to maintain the growth rate of electrical loads characterize utility planning in eastern Canada. Hydro-Electric Power Commission of Ontario joins Atomic Energy of Canada in building the 200-eMw CANDU plant **(p 54).**

Sectionalizing devices, including reclosers, give Portland General Electric Co reliable 12.5-kv circuits at reasonable cost **(p 60).**

Decision to ground and choice of method depend on the advantages sought by the individual industrial plant **(p 63).**

Meter reading by phone proves practical **(p 70).**

PROCUREMENT & PRODUCTS ▶ **General Electric Co. puts no price tag on its offer to IUE,** but wage increases will total 7% over the three-year period of the proposed contract, with lay-off pay included among benefits **(p 74)** . . . A. B. Chance Co announces 5% increase

Politics and Public Power

WHO WILL BUILD THE BPA INTERTIE?

Who would build the twin-circuit, 500-kv intertie between Bonneville Power Administration and California markets?

In its report for the State of California, H. Zinder & Associates meticulously refers to the project as a "common carrier," theoretically throwing ownership open to any or all utilities and agencies concerned.

In conversations behind the scenes, and even in published newspaper editorials, the intertie is often referred to as a "government line." This occurs often enough to lead to speculation that it might be true. A process of elimination of the possible owners lends even more strength to this thought.

Pacific Gas & Electric Co, Southern California Edison Co, and Los Angeles Department of Water & Power have the major marketplaces for the BPA surplus power. Of the three, only LADW&P is in favor of the high voltage intertie. PG&E has submitted a plan that is adequate for northern and central California, and is standing by its proposal. Edison is interested only in transmission and generation that it controls itself.

Bonneville would hardly be expected to be interested in building a $200-million transmission line to sell 2-mill dump power.

Irrigation Districts of California have power to sell, but they are siding with PG&E because they (1) have a marketplace in the PG&E territory, and (2) are concerned about power that might compete with that produced by their existing and proposed water development plans.

The State of California is paying for the Zinder studies, and therefore must be accounted for as a possible owner. But the state government's primary concern must surely be in the direction of assuring markets for the power that will be produced to help support its massive water plan—not only with importing surplus power from the Pacific Northwest.

California has now authorized Zinder & Associates to start a second phase of the study, which involves coordination of the proposed 500-kv intertie with Canadian systems and also the Colorado River

on distribution insulator prices and will institute hikes on some transmission insulators **(p 74).**

Manufacturers News: Line Material announces introduction of two new electronically-controlled oil circuit reclosers **(p 76)** . . . Lapp Insulator Co finds way to stabilize power factor, charging current, and watts loss of line and station post insulators **(p 81).**

New Equipment: Fused interrupter switch for low voltage application can interrupt 100,000 symmetrical amp . . . Station-class lightning arresters in all sizes from 3 to 276 kv are now enclosed in one-piece porcelain housings **(p 82).**

MANAGEMENT ▶ **What brought trouble to the equipment market?** Recent soft prices and the antitrust charges suggest the need for examining the attitudes of buyers and sellers—electrical utilities and manufacturers—and some factors influencing their long-time relationship. Second in a series of three articles **(p 89).**

SELLING ▶ **How much insulation is needed for electric heating?** As conditions vary across the country, it's hard to set a standard but one approach is given on **page 94.**

NEXT WEEK ▶ **The 11th annual electrical industry forecast, 1961-1980.**

Basin. This is perhaps the most concrete clue of all that somewhere in the background is the assumption that the BPA-California intertie would be federally-owned.

A combination of the federal government, LADW&P, California, BPA, and perhaps even the irrigation districts might build the intertie, but could all of the California water development power, plus the imported dump power, be absorbed? Most of these possible owners of the line have, or will have, wholesale power to sell. Without PG&E and Edison places to sell it are greatly curtailed.

What the Zinder report is showing appears to be a plan for a strong lash-up of major markets and regional generation instead of a relatively small, practical outlet for surplus BPA power, as originally proposed by PG&E.

PG&E is placed in a frustrating position because the Zinder report does not call the proposal what it appears to be.

For example, the irrigation districts now have a market for their power, provided by PG&E, and it is right next door. It is doubtful that they would be interested in investing in a "common carrier," but what would happen if a federal backbone line existed, at no cost to them, and opened up at least one other market for their power in southern California?

It is possible that the long history of cooperation between PG&E and irrigation districts (more than 30 years in at least one case) would survive the temptations offered by a federal line and a broadened market. But until the line is called what to all appearances it must be, the necessary discussions, at least in public, have to treat it as if it really is a "common carrier" that can logically be owned by interested agencies and utilities.

In the meantime, PG&E and California Oregon Power Co, who could be using BPA's surplus power to the advantage of all three, are forced to stand by while Gov Pat Brown of California explores the possibility of making a mountain out of a mole hill and political hay at the same time. The metaphors are no more mixed than the situation for the utilities and Bonneville.

Executive Reader

Admitting the wide gap that exists between the purposeful efforts of the electric companies which desire to inform the public about their business and the receptivity of the public; admitting also the frustration that has resulted from the unavailability of fully effective means to arouse the interest of a public that is inclined to be generally lethargic and noninterested, much nevertheless has been accomplished in putting the image of the companies before the public in a favorable light. The result is a much more friendly and understanding appreciation of the investor-owned companies in general, and certain of them in particular, than existed a few years ago. **Good Public Relations Program Counters Public Apathy, Harry T. Pritchard, Public Utilities Fortnightly, August 18, 1960.**

Personal and real property taxes are of special concern to us in Indiana, since those paid by utilities are out of proportion to the amount paid by industries. Fortunately, an "equalization" schedule proposed to become effective in 1961 will attempt to correct this situation. **Robert S. Webb, remarks before The New York Society of Security Analysts, Inc, August 17, 1960.**

An increasing number of managements are beginning to tell their employees the role of competition in keeping the company alive. These managements feel that the more each employee knows about his company, the better he will understand the value of his own job in relation to the company as a whole. **NAM News, August 26, 1960.**

The serious risk that the six member countries of the European Common Market would proceed to draw up engineering standards on a basis of mutual agreement, without reference to the rest of Europe, has diminished with the formal acceptance that the seven members of the European Free Trade Association should join in the discussions on standardization. The principles to which British representatives are adjured to have regard include a "willingness to effect reasonable compromise" with other participating countries, which implies some willingness to withdraw from insisting on what one is convinced is best. **Electrical Times, August 4, 1960.**

Business can look for better news after Labor Day. It needs some encouragement. Summer reports from a number of the heavy industries were unsettling, and at times the economy seemed in danger of losing flying speed. This month, however, car assemblies should rise to 460,000, an 80% advance over last year, as Detroit makes an early start on 1961 models. This should in turn lift the steel industry out of its summer doldrums, when operations were at only 55% of capacity. Most important, the quickening now under way in government spending will soon take hold in the economy. **Fortune, September, 1960.**

An experimental embankment built in Bedford a little over a year ago to simulate a typical road section has had to be demolished by blasting following the failure of a bulldozer to make an impression on it. The embankment, built for demonstrations, was constructed from fly ash. **Electricity, July-August, 1960.**

Reductions this week in interest rates that the big banks ask of their best customers on loans may strengthen spending on equipment. It must be said, though, that the banks were in no hurry to take the step and that it was grudging in many instances when it came. This implies that money isn't going to be much cheaper for most borrowers. Some bankers, in fact, said this week that they are not yet ready to cut rates for those borrowers who are poorer risks. **Business Week, August 27, 1960.**

Still in one piece

Frames from a high speed motion picture showing, successively: venting of gas through the Thorex pressure-relief system at the instant of fault current initiation, clearing of smoke and dust cloud, and the intact housing (far-right) after the test was completed.

Thorex arrester on pressure-relief test survives massive fault current... intact!

Output of several 230-kv transmission lines was added to 75 per cent of the total capacity of one of the country's largest hydro plants to produce the massive fault current used in this test of Thorex arrester internal pressure relief.

Station Class Thorex Type MPR arresters, with internal parts damaged to assure failure, were subjected to a symmetrical rms current of 23,000 amperes which, with offset, gave a 43,500-ampere crest. These arrester housings survived this fault current with all parts completely intact.

Factors contributing to this are (A) Pressure-relief diaphragms, at both ends, larger than the internal diameter of the arrester housing. (B) Direct-acting relief provisions, sensitive to *pressure only*, and functioning in an instantaneous single step. (C) A clear internal path of generous size, not impeded by any circuit parts, passes the rapidly traveling pressure front to the relief diaphragms.

There may come a time when an arrester is expected to fail. When that happens, its ability to remain physically intact can save costly damage to surrounding equipment. Thorex Dynagap Type MPR Station Class arresters have generous safety provisions for such an emergency, demonstrated by severe field testing.

Here is just one more of the many proven reasons why you should specify Thorex Dynagap lightning arresters on your next station construction.

OHIO BRASS COMPANY, MANSFIELD, OHIO

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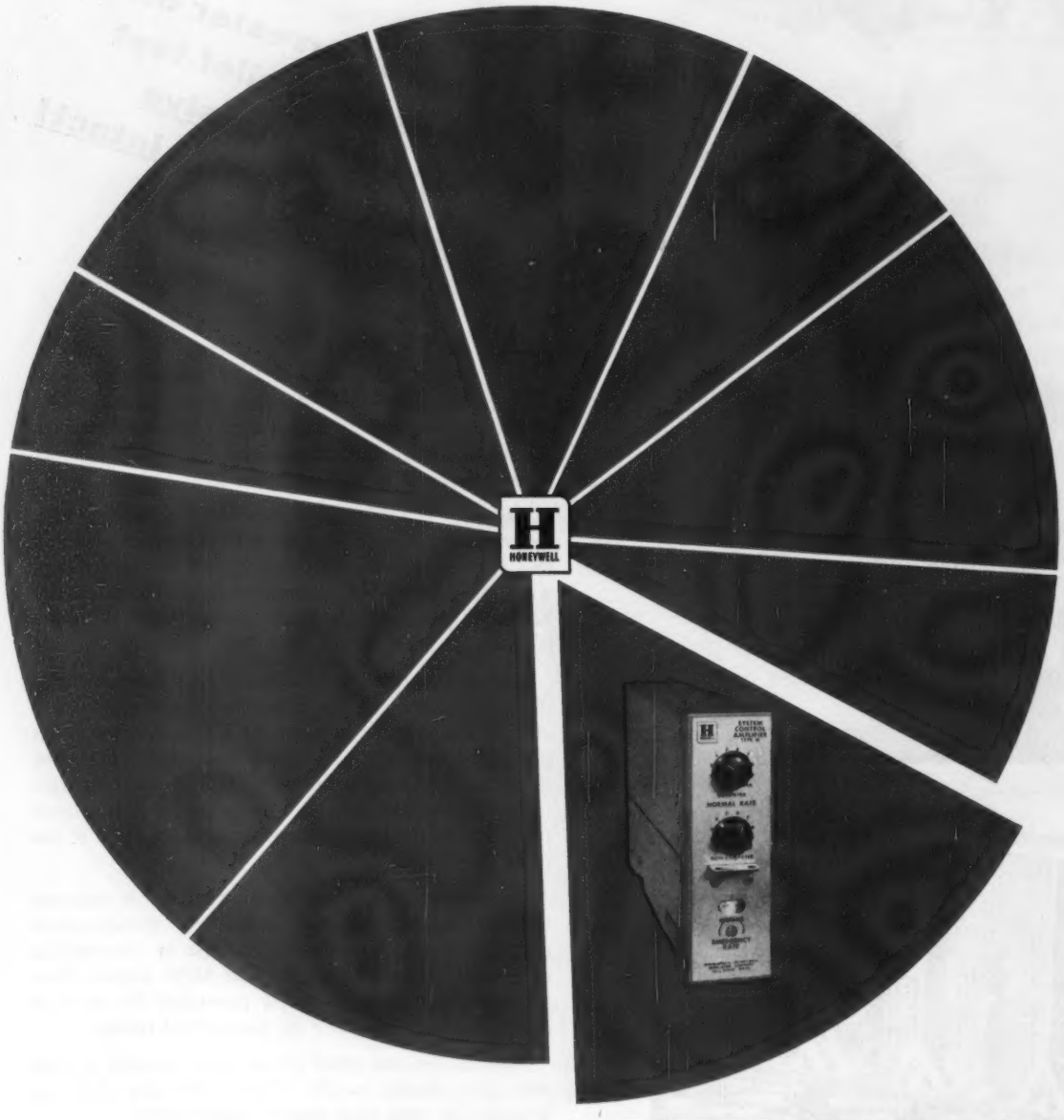
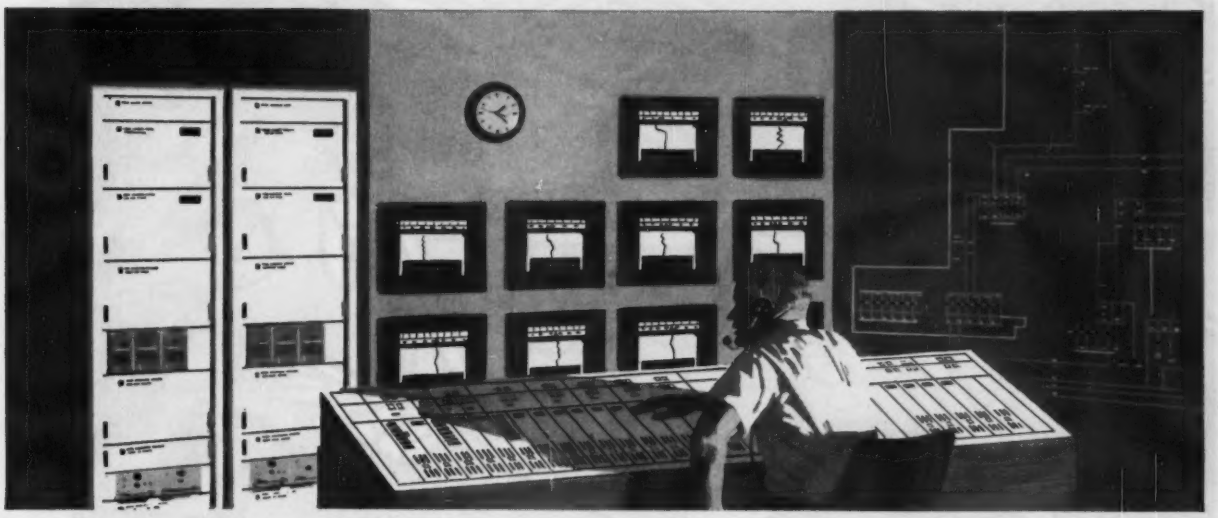
PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

NEW SOLID-STATE LOAD-FREQUENCY SYSTEM



HEART OF THE SYSTEM is this transistorized control amplifier. One basic amplifier performs various computing, measuring, alarm and control functions. Speed of response is easily changed with the turn of a knob. Six amplifiers can be mounted in a single standard 19-inch relay rack using only 8 inches of vertical space.

—A MAJOR ADVANCE IN GENERATION CONTROL



Meet power demands precisely and cut generating costs with Honeywell's new load-frequency control system. It introduces solid state techniques that bring new reliability levels to automatic generation control and sharply reduce maintenance. For computer control, you can use the new Honeywell 290 industrial digital computer to mastermind the system and simultaneously compute cost data for interconnection billing.

Major components: High-speed, transistorized telemetering equipment transmits tie-line loads to the dispatcher and the command signal to generating stations. Control amplifiers perform computing, measuring, control and high and low alarm functions. Governor motor actuators control generator loading in accordance with command signals. Rate limiters hold the rate of change of generation within prescribed allowances. Incremental loaders apportion generation on an economical basis.

Easy maintenance: All components are of interchangeable, plug-in, modular design, and are easily accessible while the system operates. Slidewires, motors, gear trains, and vacuum tubes are eliminated. Use of transistors and other solid-state devices throughout cuts space requirements in half and drastically reduces heat buildup. All critical test and calibration points are compactly packaged in a single module, to provide a centralized test area and further simplify maintenance.

Honeywell's new load-frequency control system is a development of first importance in the power industry. Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Penna. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

75th YEAR — PIONEERING THE FUTURE

Honeywell

First in Control

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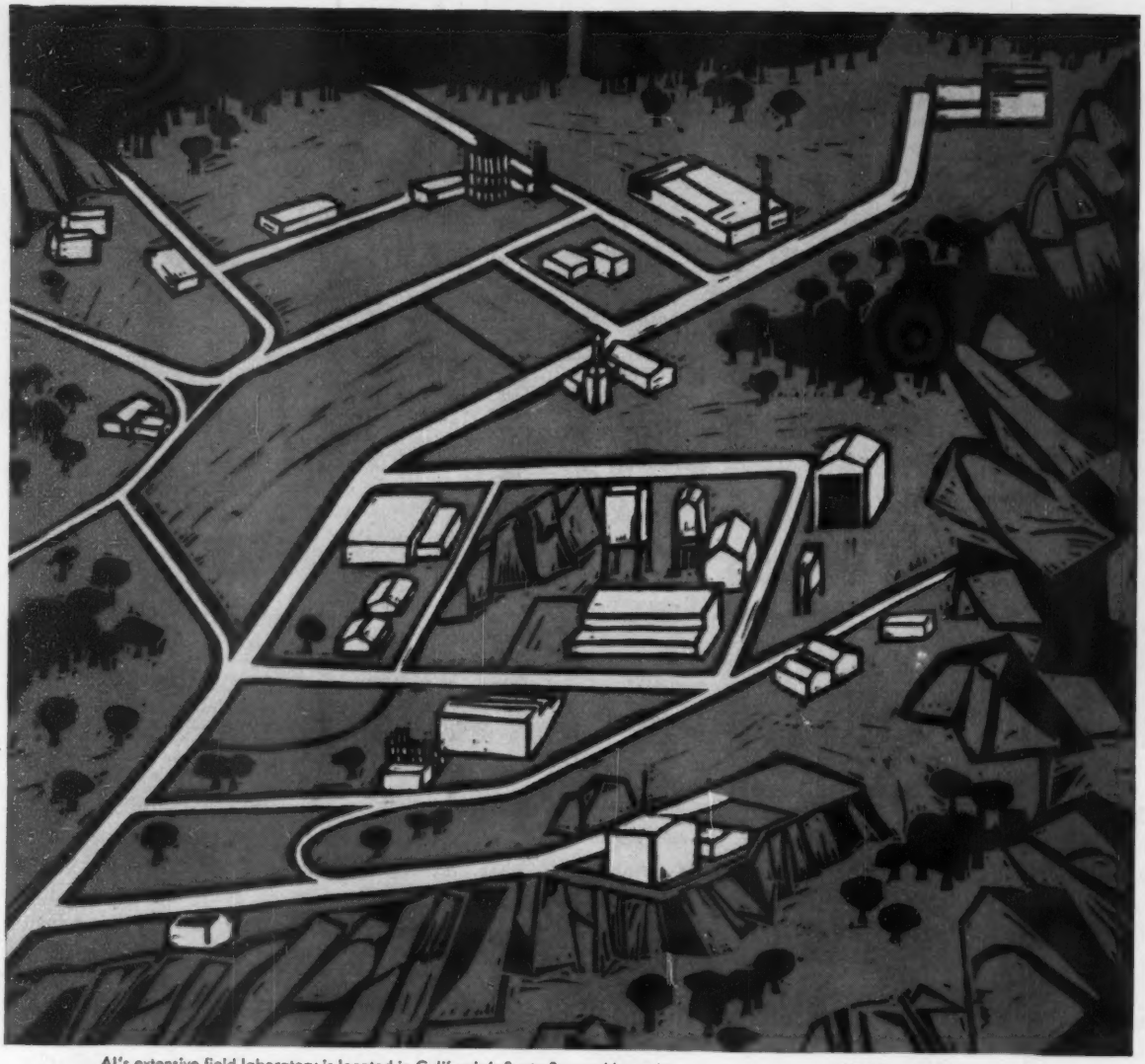

AI's extensive field laboratory is located in California's Santa Susana Mountains. *Woodcut by Edward Kysar.*

How can A.I. facilities help you plan a Nuclear Program?

In the picturesque Santa Susana mountains near Los Angeles, Atomics International has built an extensive field laboratory for research, engineering and testing in the nuclear sciences. Here, and at a headquarters complex in the valley below, men who pioneered the creative uses of atomic energy are applying their experience to develop advanced nuclear reactors and associated equipment.

Fourteen years of experience in developing various types of reactors for the Atomic Energy Commission and other organizations have given the men of Atomics International a collective background unparalleled in the industry. The facilities at their disposal are among the most sophisticated and extensive in the world.

Results of AI's work have been demonstrated in projects for the AEC which include the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment at the company's field laboratory. Additionally, AI built and is operating SNAP II, a 220 pound prototype reactor to produce three kilowatts of electricity for space vehicles.

Atomics International is also building large power reactors for electric utilities in Ohio and Nebraska under AEC programs. Studies are underway for other power reactors in the United States and Europe. Research reactors have been built by AI for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the United States.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

PIONEERS IN THE CREATIVE USE OF THE ATOM

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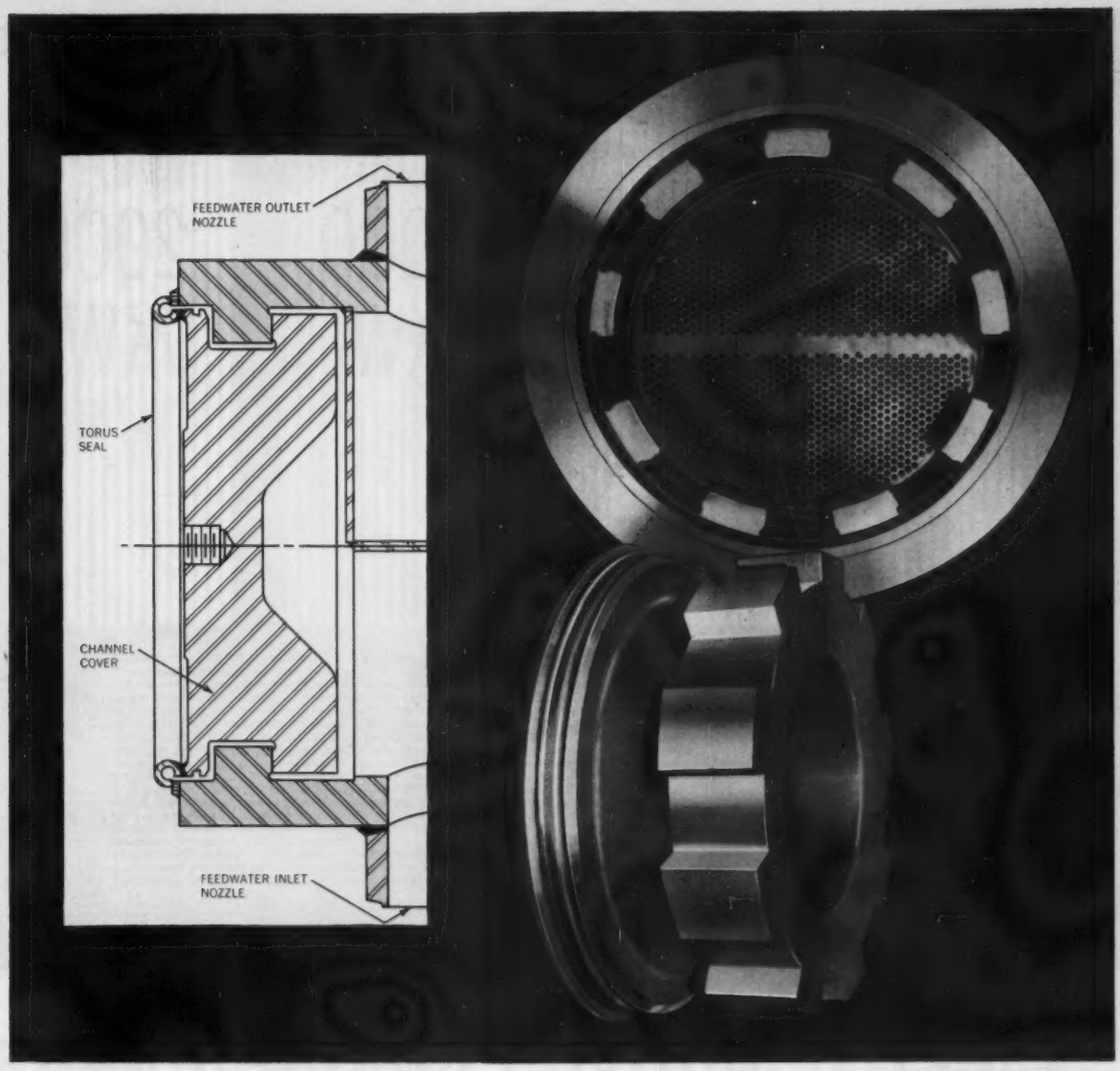

New Breech-Lockhead for Feedwater Heaters

This new closure combines quick-opening convenience with an all-welded seal that is *gasketless*. It is leakproof under the most severe thermal shocks. Yet the pressure cover can be removed quickly with simple tools.

The new Breech-Lockhead closure consists of two parts: (1) a pressure cover that resists the hydrostatic pressure by means of interlocking lugs on the cover and channel, and (2) a torus seal consisting of a partial torus welded to the edges of the channel and cover by a simplified welding procedure.

The torus provides a leakproof seal independent of the hydrostatic pressure on the cover.

Assembly and re-assembly are facilitated by carefully designed tools furnished with the feedwater heaters. The speed, simplicity and ease of the entire operation are worth investigating.

More specific information will be sent on request. Address your inquiries to Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.

Heat Engineered products, plants and processes . . . for the world's industrial progress.

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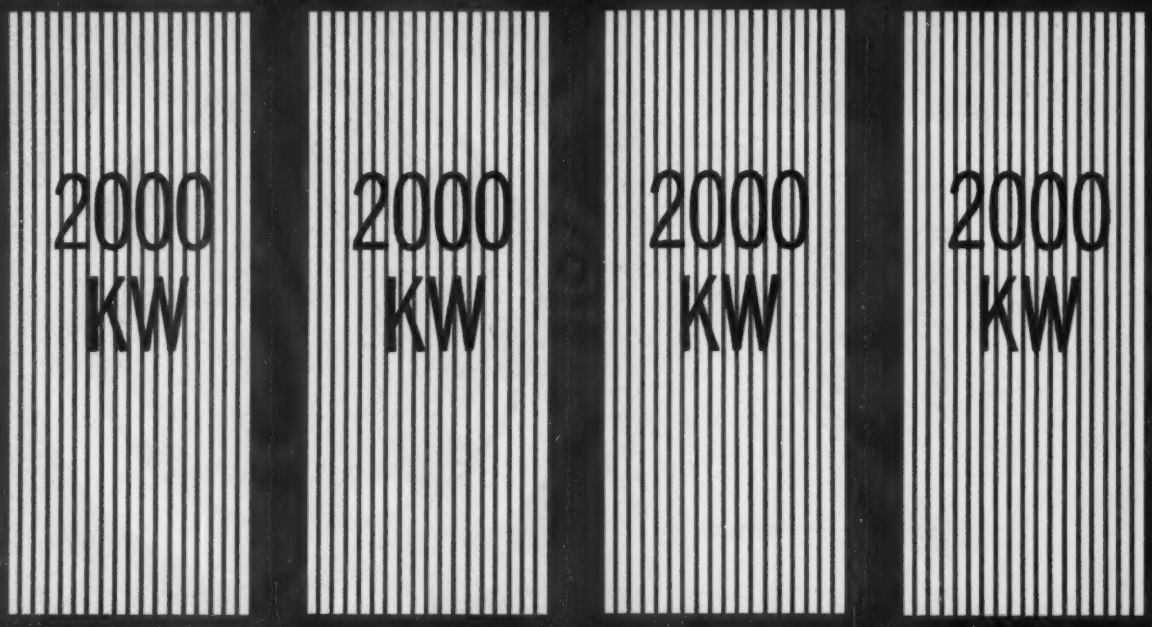


Electro-Motive Peaking Plants

New MU-100 plant $82 per KW, F.O.B. Electro-Motive Factory

For those utilities seeking higher capacity peaking power, the new Electro-Motive 10,000 KW plant offers low investment per KW (as low as $94 per KW installed at site) plus new operating and control features not found on other types of equipment.

Highly flexible. The MU-100 may be utilized in peaking, reserve or area protection applications. It may be remotely operated by a variety of methods—automatically by voltage or current sensing devices, and by supervisory control such as leased telephone line or by carrier current. Self-contained design permits location at the step-down substation serving the load. Installation is simple and inexpensive, and the plant may be moved at any time to match changing load conditions.

Future expansion flexibility. Smaller Electro-Motive plants (2,000, 4,000, 6,000 and 8,000 KW) can be installed now with control equipment in place to expand later up to 10,000 KW.

By taking advantage of this plan-ahead feature, additional KW capacity can be added later for less than $75/KW *installed*. For example, total end cost for uprating from 2,000 KW to 8,000 KW is the same as the initial cost for an 8,000 KW plant.

New controls. The plant control contains many innovations which further extend flexibility. The plant may be operated remotely at various capacities to match load conditions. Each generator produces 2,000 KW—and each may be operated individually or

NOW + 2000 KW

now available up to 10,000 KW

in any combination. Thus, the plant will provide 2,000, 4,000, 6,000, 8,000 or 10,000 KW. With selective control a block of power is always available—even during maintenance.

Fast start. From a cold start, the MU-100 is on line carrying load in less than three and one-half minutes. A spinning reserve start has been designed into the plant which reduces starting time to a minute and a half.

With the addition of the MU-100 to the Electro-Motive line, the most complete range of capacities is available in specialized peaking equipment. Thus it is possible to match capacity to need for the most efficient operation and lowest investment. An increase in demand is handled by expanding the plant—at low incremental cost—with additional generating components.

An analysis of utility peaking needs will reveal the savings possible with the application of Electro-Motive equipment. Ask the Electro-Motive representative for information.

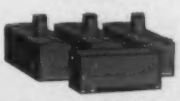
ELECTRO-MOTIVE DIVISION
GENERAL MOTORS · LA GRANGE, ILLINOIS

Sales-engineering offices: Chicago, New York, St. Louis, San Francisco

In Canada: General Motors Diesel Limited, London, Ontario

MU-20 2000 KW Diesel
MU-14DF 1000 KW Dual-fuel

MU-40 4000 KW Diesel
MU-28DF 2000 KW Dual-fuel



MU-60 6000 KW Diesel
MU-42DF 3000 KW Dual-fuel

MU-80 8000 KW Diesel
MU-56DF 4000 KW Dual-fuel

MU-100 10,000 KW Diesel
MU-70DF 5000 KW Dual-fuel

for the latest data on ACSR

126 fact-filled pages...from Alcoa

It took more than 60 years to prepare these three publications.

Recently completed tests have made it possible to review and revise data accumulated since 1897, the year Alcoa launched a continuous research program on overhead aluminum conductors— *both all-aluminum and ACSR.* The most up-to-date information has been put into book form to help you in your job:

Design or operation of transmission lines is your problem. Maybe you're called on to predict the resistance and reactance of a proposed transmission line. Are available data good enough? This 90-page book supplies you with new information on resistance and reactance—information that can help you accurately evaluate the effects of the steel core on electrical characteristics. TITLE: *Resistance and reactance of aluminum conductors.*

How much heat loss can you expect from convection? Tough problem. One that's complicated by the chimney effect of a heated conductor. And varying wind conditions. This 20-page publication provides up-to-date information on heat dissipation caused by convection and radiation. TITLE: *Current-temperature characteristics of aluminum conductors.*

Electrical requirements on your system go up. You need to operate conductors at higher temperatures than in the past. You ask yourself: what about creep effect? Here's a 16-page booklet that provides easy-to-use answers to many questions on how aluminum conductors behave when subjected to various conditions of heating by high overload currents. TITLE: *Overload and fault current limitations of bare aluminum conductors.*

Ask any one of our representatives for your copy of these new publications. Written requests on company stationery should be mailed to Rome Cable Division of Alcoa, Dept. 1-90, Rome, New York.

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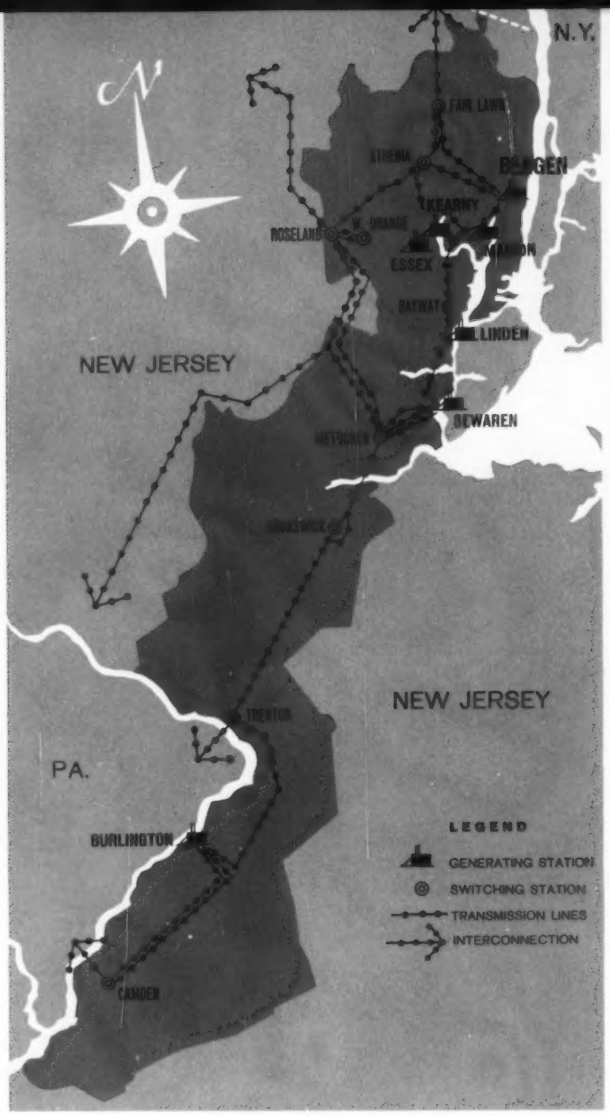
DIVISION OF **ALCOA**

New Bergen Generating Station helps Public Service Electric and Gas Company of New Jersey meet huge load growth

The Meadows, 50,000 acres of swamp, is the last frontier in the industrial development of northern New Jersey.

In the construction of Bergen, 4400 concrete piles were driven to refusal. The average length of each pile was 105 feet. A total of 800,000 cubic yards of fill was needed for the immediate area of the station. In all, over 45,000 cubic yards of concrete and 8000 tons of structural steel were used.



$110,000,000 Bergen Generating Station added to Public Service system

THIS 580-MW INSTALLATION IS THE LARGEST WESTINGHOUSE COORDINATED PROJECT TO DATE. Bergen Generating Station is the largest operating station in the Public Service system, and is a part of the $500,000,000 expended for construction in the last five years. With its two 290-mw units, Bergen adds 20% to installed generating capacity bringing the system total to 3,154,000 kilowatts. Bergen's 580 megawatts of new generating capacity now team up with the other six operating stations in the Public Service system to supply more than 1,390,000 customers in 223 New Jersey communities.

Beefing-up activity on the system provided four new substations and additional capacity at many existing substations. Levittown, a 15,000-home community under development in Burlington County, is the first beneficiary of a new high-voltage distribution system. Voltage was raised from 4150 to 13,200 volts . . . increased capacity cut number of substations, improved service.

Public Service is interconnected with neighbors in New Jersey, Pennsylvania and Maryland in system interchange. New generation from Bergen brings total capacity of this power pool to over 12 million kilowatts. The pool, in turn, is tied in with systems in New York, New England and the Washington area.

All of these measures are proving highly effective. Thorough-going system integration and system tie-ins are assuring an improved degree of service reliability during both daily and seasonal load peaks. You can be sure . . . if it's Westinghouse.

CP 1058 Litho in U.S.A.

Westinghouse

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

Westinghouse designs unique turbine-generator . . . first cost, operating costs plummet

Jersey straddles main transportation routes of the East, spawns new industry along city belt

Benjamin Franklin once described New Jersey as a "barrel tapped at both ends," pouring its people and produce into Philadelphia to the South and New York in the North.

Lying along the corridor linking Philadelphia and New York is the territory of Public Service Electric and Gas Company of New Jersey, serving over one and a third million customers. Demand on electrical service in this area has set new records for each of the last 12 years. In 1959, a peak of 12¾ billion kilowatt-hours of output was reached.

The growth of New Jersey, which has caused Public Service to increase capacity tenfold in 40 years, shows no signs of abating . . . promises to be even more spectacular in the 1960's. Use of electricity in homes and in commerce is increasing substantially and continuously. Spiralling power sales to plants signal even greater growth and diversification of the state's industry. In 1959, for example, over 180 new plants sprang up on the system.

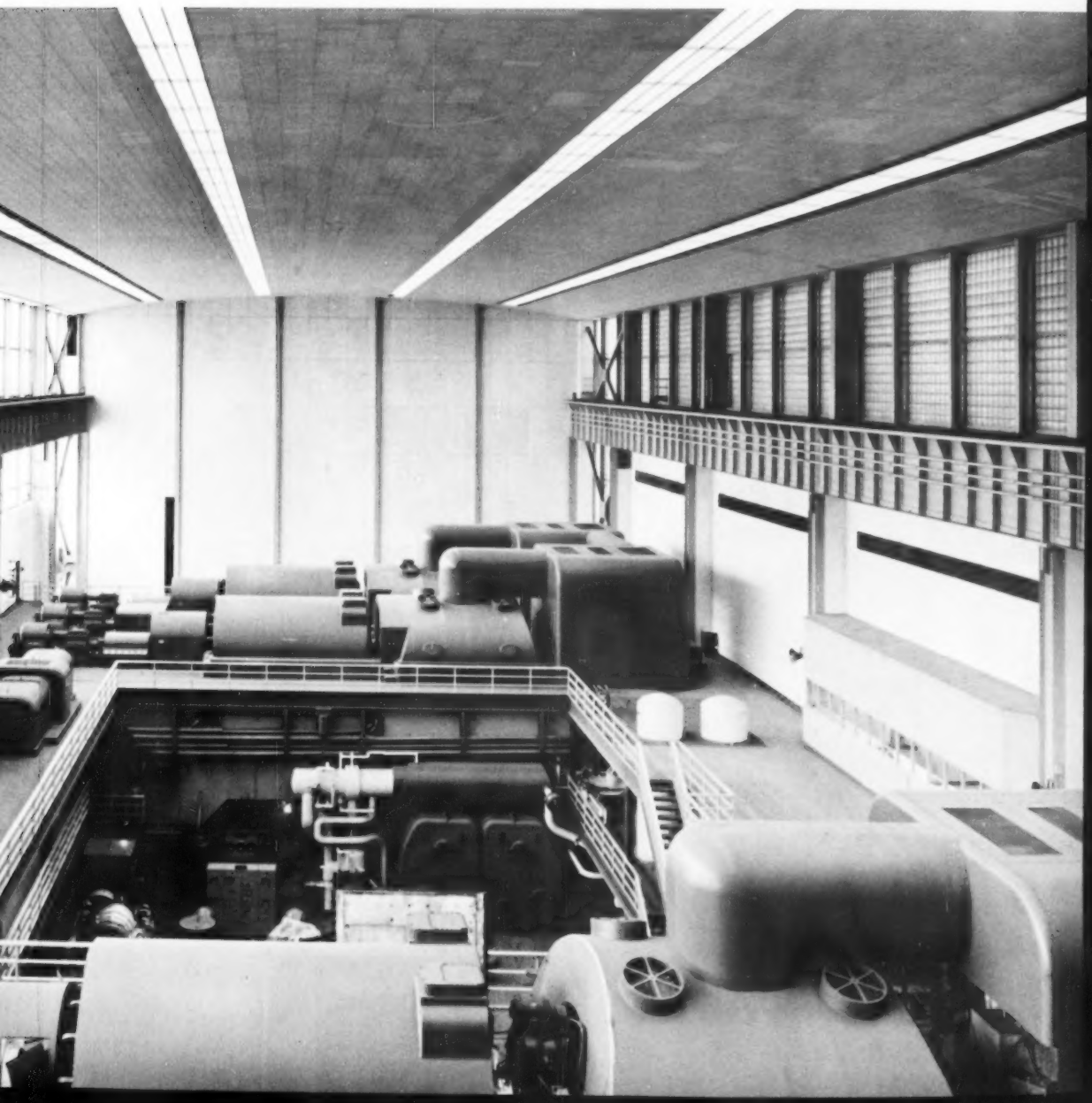
At the outset, Public Service stands to save a half million dollars in original cost by virtue of an unusual design idea.

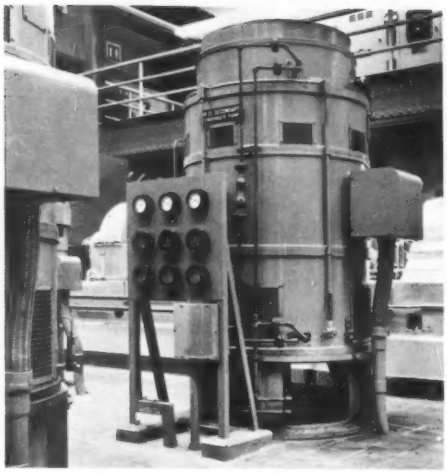
Pioneered jointly by Westinghouse and the utility is a new concept in large turbine-generators. Bergen's two 290-mw, cross-compound, 3600-rpm units are identical twins with high-pressure equipment on one shaft and the intermediate pressure on the other. Four identical generators and low-pressure turbines result in a major integration of components and compactness of design that are translated into substantial savings in initial station costs. Among these are lighter foundations, less space, lower shipping and handling expense.

Boiler feed pumps are driven by the generator shafts, eliminating the customary motors and controls, and stepping up operating efficiency. In addition, requirements for auxiliary electric power are cut.

The inlet pressure of this quadruple-flow machine is 2350 psig, with initial temperature of 1100°F with one reheat to 1050°F. The generators are hydrogen inner-cooled through both stator and rotor.

Here is one more example of how Westinghouse and the electric utilities are designing toward lower capital investments and higher practical capacities in an era of booming power loads.





Reliable high-speed vertical motors...

The world's largest high-speed vertical motors power Bergen's six secondary condensate pumps. At 900 hp, these motors are over 28% more powerful than the previously largest 3600-rpm vertical motors.

Bearings and their lubrication and cooling are the keys to such high-performance vertical-shaft machines. The Kingsbury-type bearings are of Westinghouse manufacture. They are oil-lubricated with water cooling.

Entire alarm system checked in minutes...

A unique static annunciator system was custom-engineered for Bergen by Westinghouse and Public Service. The system monitors 560 critical points in the station. Maintenance is reduced to a minimum by the use of static system components with an easy-to-replace design.

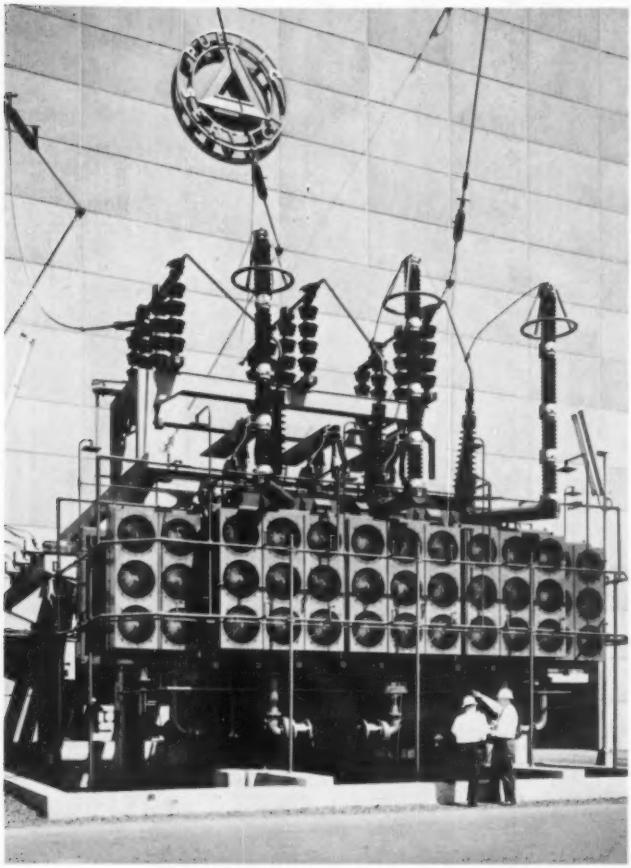
Westinghouse Cypak® logic elements were integrated with magnetic amplifiers to form an alarm system which provides a new standard of reliability. There are two different audible alarms plus flashing light and steady light indications. These four signals assure positive trouble-spotting, even while the system is undergoing periodic checks. Testing the new system is greatly simplified over previous annunciator applications.

The test station, as well as all of the components of this wholly static system, is located in the control room. There, one man can check the entire 560-point system in a matter of minutes.

Versatility unlimited...

The 4150-volt metal-clad outdoor switchgear used in the Bergen Generating Station is typical of Westinghouse switchgear. In addition to the inspection and test convenience offered by the horizontal drawout Type DH breakers, reliability of the metal-clad switchgear is assured by its factory-assembled wired-and-tested construction—benefits of standardized unit design. In addition, unit responsibility and coordination of all components assure longer life, installation economy and long-term maintenance savings . . . all designed into Westinghouse equipment.

POWER CENTERS also are matched to the electrical functions of Bergen. Among the many advantages of these units are the operating conveniences and safety of Type DB breakers used in low-voltage switchgear. Their three-position drawout features allow them to be placed in the connected, test or disconnected position with the cell door closed—a positive safety characteristic.



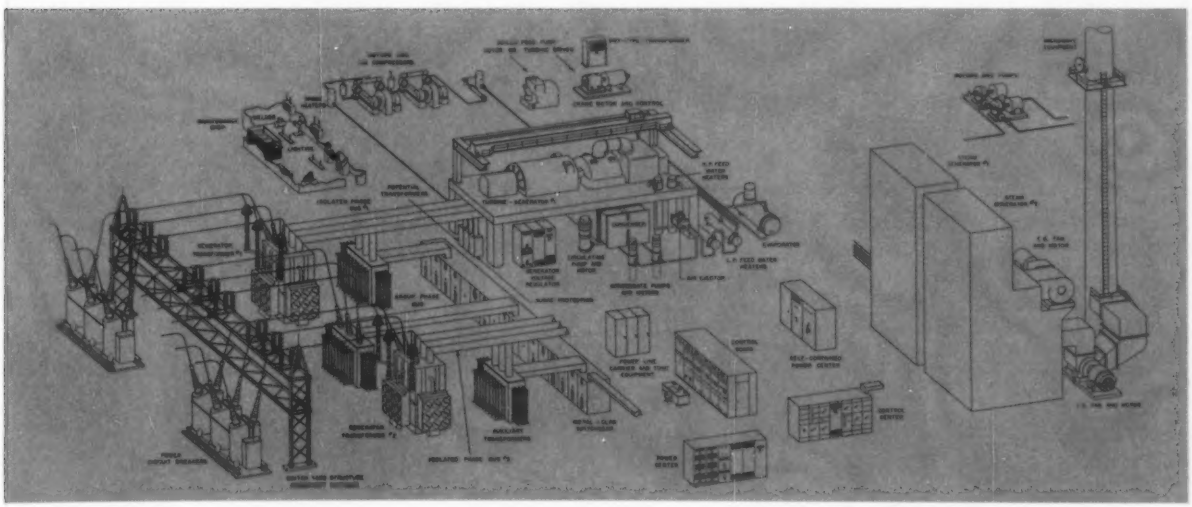
Compact and reliable . . .

One of twin units, this 325-mva, 138-kv Westinghouse transformer moves Bergen's power through as compact a design as can be bought. Three features are responsible for this smaller, lighter equipment that must stand on Jersey's bog.

First, forced-oil cooling with forced-air cooler. The result is efficient, continuous cooling and the smallest transformer at the lowest initial expense for any given rating.

Second, Westinghouse exclusive "Form-Fit" design. Snug fit of tank and core-coils reduces the amount of oil required and, again, slashes dimensions and weights.

Third, shell-form construction. Long, straight ducts permit oil to move freely from bottom to top. This factor, plus the high volume flow of forced circulation, means maximum coil-to-oil contact and heat transfer. The inherent efficiency of this arrangement reduces the amount of construction hardware and, together with the bulk-saving of forced-oil cooling and Form-Fit design, cuts foundation weight and cost.



These are only a few of the benefits which Public Service has realized from these unexcelled ideas in Westinghouse transformer design. Longer equipment life, increased safe-overload capacity and lowered maintenance of Westinghouse transformers have accrued proved savings of $100,000,000 for the electric utility industry.

This is an account of how one utility met the challenge of progress and its load demands . . . and how Westinghouse cooperated with engineering experience and equipment. Your Westinghouse representative can bring you similar assistance. The wide variety of coordinated equipment he is prepared to supply is diagrammed above, in part. Call him for the most complete service available in the industry. You can be sure . . . if it's Westinghouse.

Westinghouse

Need Copperweld Ground Rods or Clamps in a hurry? Just contact any of the following Pole Line Hardware Manufacturers or their Jobbers—located from coast to coast. They have large stocks available for quick delivery to you.

A. B. CHANCE COMPANY
210 N. Allen St., Centralia, Mo.

HUBBARD AND COMPANY
200 S. Michigan Ave., Chicago 4, Ill.

JOSLYN MFG. AND SUPPLY COMPANY
155 Wacker Dr., Chicago 6, Ill.

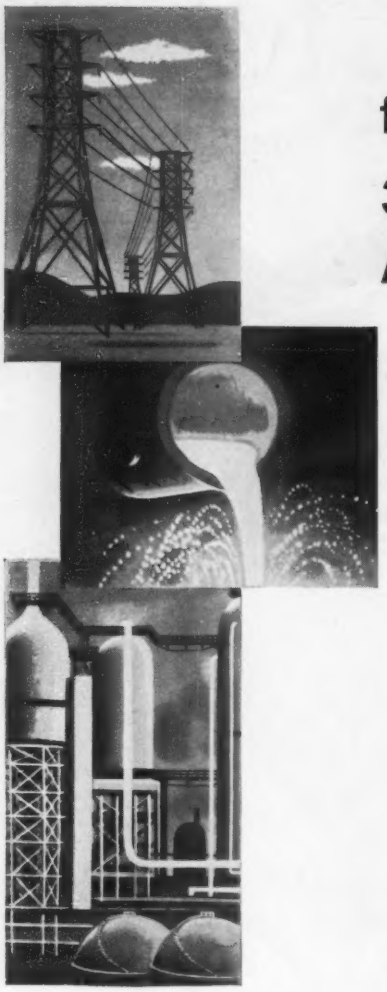
LINE MATERIAL INDUSTRIES
700 W. Michigan St., Milwaukee 1, Wis.

OLIVER ELECTRICAL MFG. COMPANY
170 Angell St., Battle Creek, Mich.

Millions of Copperweld Ground Rods—the only molten-welded rods—are in use protecting billions of dollars worth of equipment.

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, N.Y.

RCA-110 Industrial Control Computer
RCA-130 Industrial Data Transmission Link
RCA-150 Industrial Data Analyzer and Recorder



from RCA...

3 NEW Electronic Systems that Advance Industrial Automation

. . . with capabilities that range from simple automatic monitoring and recording to complete real-time computer control of a complex "automated" operation over a wide geographical area.

Specifically designed for industrial applications and environment, the **RCA-110 Industrial Control Computer System** provides around-the-clock operating reliability, highest arithmetic speed and lowest cost installation. One megacycle, solid state circuits are conservatively operated. Optional sizes of random access core memories for working storage are combined with magnetic drums for bulk storage to provide greatest speed and desired memory size at reasonable cost. All options program-compatible with each. Easily expansible in field. Automatic priority program interrupt increases operating efficiency, permits continuous automatic self checking and enhances programming ease. Accepts binary or decimal data. 24 bit word length. One or two address. Seven index registers. Seventy-one instructions. Addition time, including access—56 microseconds. Strong, dust-tight, industrial housings are internally air conditioned. Slide-out chassis and built-in maintenance control panel permits fast front-of-cabinet maintenance.

RCA-130 Industrial Data Transmission Link removes the limitation of distance in an automatic monitoring or control system. Provides reliable on-line, real-time, telemetering, alarming and remote control signal transmission of analog or digital information via wire or radio, one-way or two-way. 100% parity check of digital information. 100% continuity check of communications circuit. Frequency shift tone keying. Frequency multiplexing or time sharing of channel as desired. Remote reports may be self-initiating or centrally sequenced. Low power requirements. Application engineered from standardized modules to completely fulfill specific requirements at minimum expense. Operates with RCA-110, RCA-150, or custom display and supervisory operating console.

High-speed, automatic monitoring and analysis of process and production status is provided by the **RCA-150 Industrial Data Analysis and Recording System**—plus computational capability for summarizing, averaging, totalizing and linearizing. Automatic alarms of process malfunctions. Accepts up to hundreds of inputs at a rate up to 1,000 points per second, with programmed or sequential scanning. Provides outputs for display panel, punched paper tape and typewriter, with provision for automatic standby. Display log format and speed to purchaser's specification. Internal, analog-to-digital conversion. All solid state circuitry, packaged for industrial environment, with optional internal air conditioning.

For special industrial control problems, **Custom Systems** can be supplied to fit your exact needs.

RCA Industrial Monitoring and Control Systems are available with Foxboro instrumentation.

For detailed information on the capabilities of RCA advanced Industrial Control Systems, consult your nearest Foxboro representative, or write—Industrial Computer Systems Department, Electronic Data Processing Division, Radio Corporation of America, 21 Strathmore Road, Natick, Massachusetts.

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

ALLIS-CHALMERS

One of three 96-inch **Howell-Bunger** valves in operation at the U. S. Engineers Mud Mountain Dam, White River, Wash.

2 ways to air-cushion a big splash

...and provide easy regulation of free discharge

***Howell-Bunger* valves** produce an expanding, aerated water jet that dissipates tremendous energy with minimum erosion and cavitation — and virtually no vibration. They're ideal for free discharge with high to low heads, into atmosphere or water. Lowest in initial cost... economical to install (need pipe line or conduit of *minimum* size). Only one moving part in contact with flow.

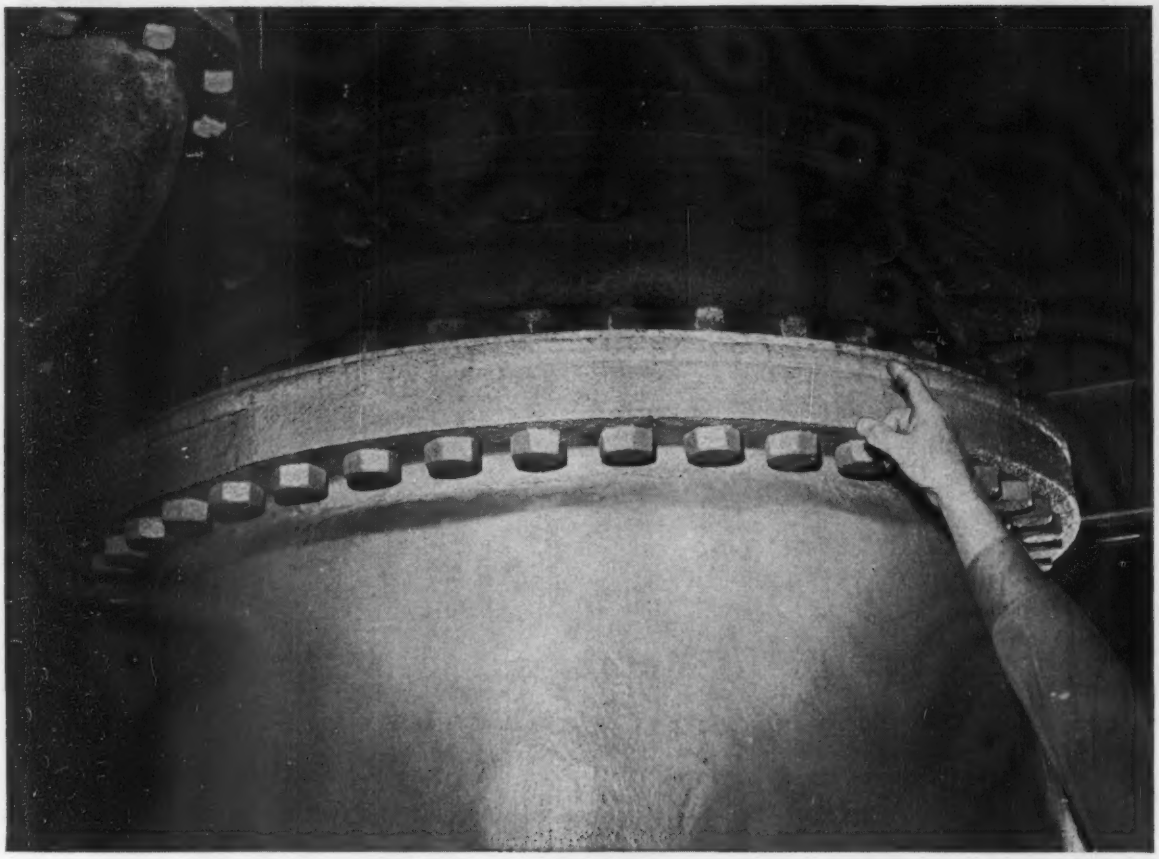
***Ring-Jet* valves** yield a concentrated, aerated jet, perfect for locations requiring reduced spray. A logical development from the *Howell-Bunger* valve, they offer many parallel advantages ... are equally suited to high and low heads.

Only Allis-Chalmers is geared to equip complete hydro installations — turbines, generators and auxiliaries. Contact our office in your area for information. Or write ***Allis-Chalmers,*** *Hydraulic Division, York, Pennsylvania.*

A-1256

One of two RING JET valves used for irrigation bypass from Tulloch Dam, California.

US RUBBER EXPANSION JOINTS



INSIDE STORY THAT'S PLENTY SALTY

The Jersey Central Power & Light Co. (Werner Station), South Amboy, N.J., has a condenser which handles 475,000 lbs. of steam per hour. Sea water is pumped into it at 35,000 gallons a minute.

Two U.S. Rubber Expansion Joints are used in this operation: One on the inlet and the other on the discharge end. They not only resist the salty sea water, but they rise and fall with the condenser. This condenser must be permitted to rise and fall according to the steam load. Only a U.S. Rubber Expansion Joint would function this way—a brittle or stationary joint would not.

These joints have been performing without let-up since 1953, six trouble-free years in teamwork with the condenser. Many more trouble-free years are expected from these "U.S." Joints.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

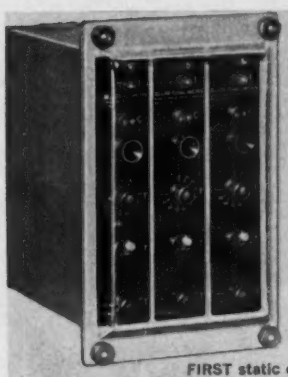
US RUBBER Mechanical Goods Division

United States Rubber

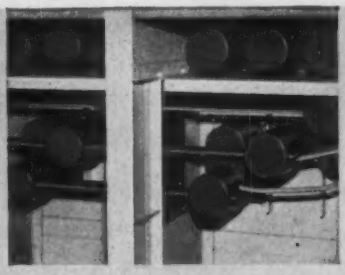
WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

ALLIS-CHALMERS



FIRST static overcurrent relays



FIRST with track-resistant, glass polyester insulation with primary stud and bus joint

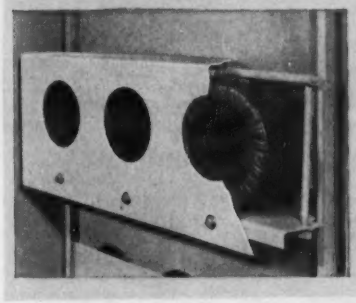
FIRST eye-level instrumentation switchgear

FIRST epoxy-resin potential transformers, trunnion mounted

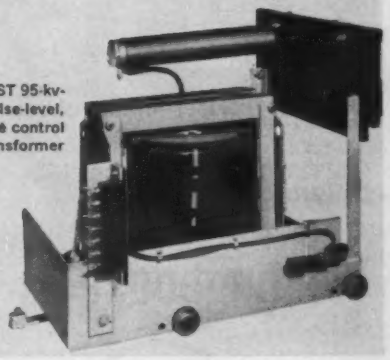
1ST

FIRST Aluma-Clad walk-in aisle switchgear

FIRST front-access current transformers



FIRST 95-kv-impulse-level, dry-type control power transformer



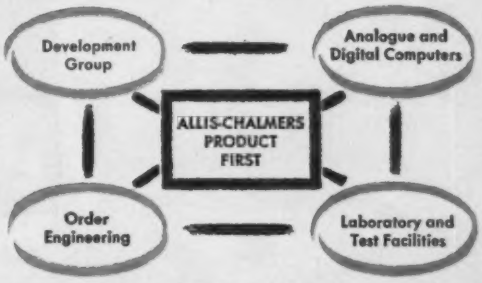
...from the company that put

Progress in Switchgear

For 113 years Allis-Chalmers has built a reputation for the finest products in the industry. A-C is continuously developing new ideas, new techniques and new products to serve you better. This same leadership spirit has quickened the pace of switchgear progress. It's responsible for the firsts illustrated above. These testify to one company's research and engineering *action*.

There are still better things to come in switchgear. You'll get them all when you specify better switchgear... designed, built and *guaranteed* by **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin. A-1357

Aluma-Clad is an Allis-Chalmers trademark.



Intradepartment teamwork bridges all gaps . . . smoothly integrates information, machines and men . . . speeding overall progress in Allis-Chalmers switchgear.

new PR recloser timing mechanism key to complete system coordination

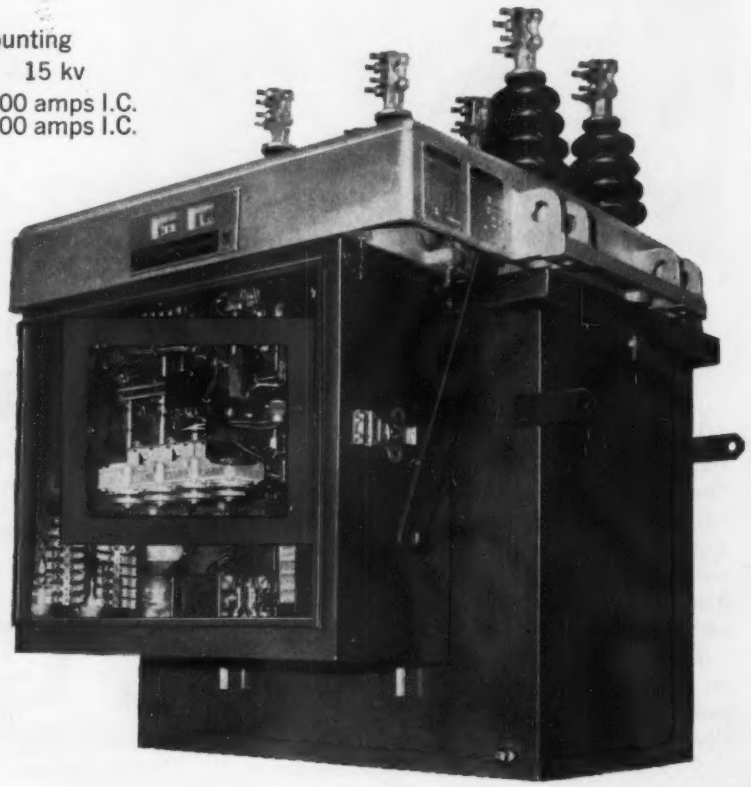
A new sealed pneumatic-spring timing mechanism with the industry's widest range of adjustability is the key to complete coordination of your distribution system's protection. Here's how this accurate and easily calibrated mechanism solves the problem. PROBLEM: To secure complete operation coordination of substation protective device with high side fuse or relay, thermal ability of the transformer, and distribution reclosers or fuses. SOLUTION: Plot time current curves of high and low side protective elements—then draw in a curve that coordinates with these. Then simply calibrate the PR recloser to match this curve—or specify it with the PR. ■ Whether it is a fuse link, CO relay or hydraulic recloser you are matching, the PR recloser can be adjusted to give complete coordination. ■ All control components are clearly identified, and permanently attached instructions make adjustments easy. Indexed, knurled knobs on the pneumatic timers and locking devices make all settings hand operated. ■ For full information on how the new Westinghouse PR recloser, with the industry's most advanced timing mechanism, can fulfill your system's coordination needs, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse.

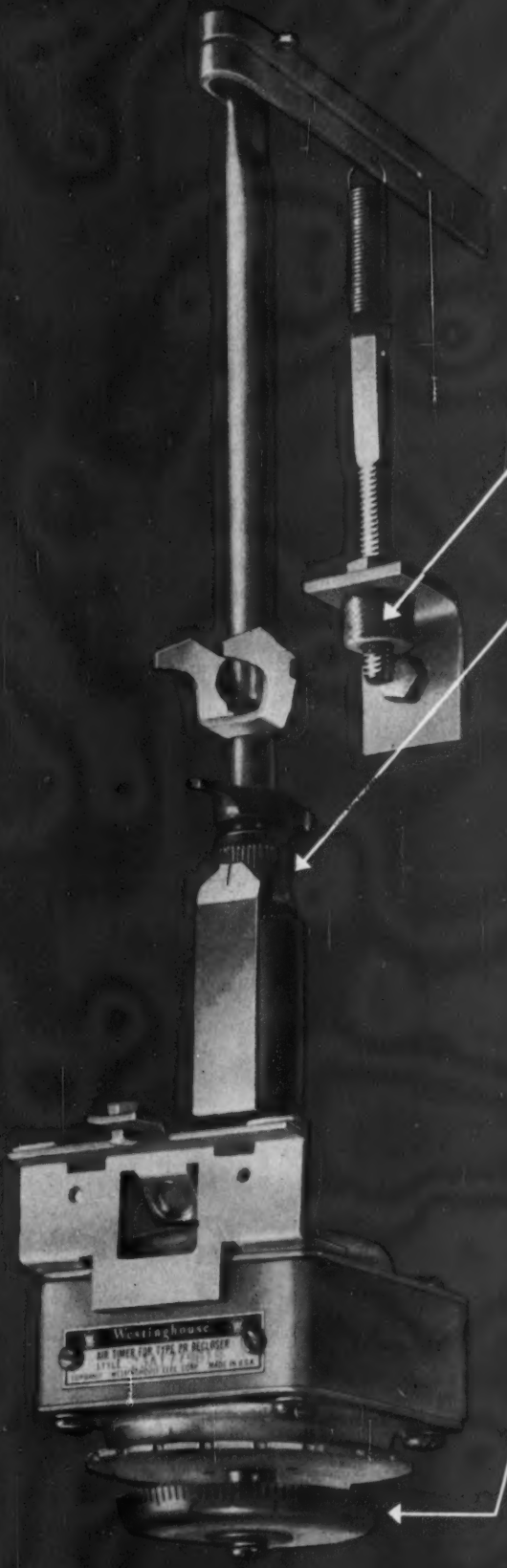
J-60996

PR recloser—frame of pole mounting

	4.8 kv	15 kv
400 amps	6000 amps I.C.	4000 amps I.C.
560 amps	12,000 amps I.C.	8000 amps I.C.

Westinghouse

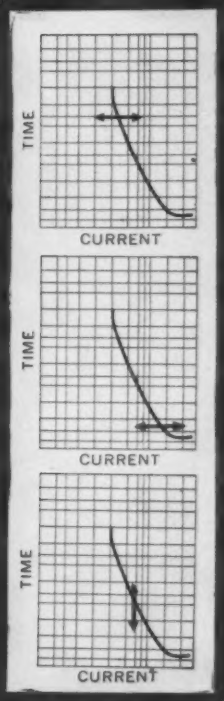




X—Minimum trip current adjustment, knurled nut provides finger-tip accuracy.

Z—Slope of curve adjustable over wide range.

Y—Shape of curve adjustment with sealed pneumatic timer vernier and locking wheel.



With X–Y–Z adjustments, a composite curve can be produced to coordinate with fuses, reclosers or relays.

BARTLETT

More than 13 years ago Bartlett successfully pioneered the use of the helicopter for shade tree spraying—an operation that was to lead the way, a few years later, to a new efficient method of control of woody plants along utility rights-of-way.

At first, difficult terrains presented unusual problems but gradually through research and experience, new equipment was developed and new herbicides and techniques perfected to overcome them. Today, Bartlett research in this important field is carried on continuously through college fellowships and at the Bartlett Research Laboratories.

If your right-of-way clearance, line trimming, brush control or tree survey requirements present a problem, we invite you to share our years of experience. This service is now available from Maine to Florida, and west to Illinois and Alabama.

The Bartlett Way

BARTLETT TREE EXPERTS

Home Office, 2770 Summer Street, Stamford, Conn.
Research Laboratories and Experimental Grounds, Stamford, Conn.
Bartlett School of Tree Surgery, Stamford, Conn.

Rigid steel conduit protects wiring permanently

Steel

for Strength
... Economy
... Versatility

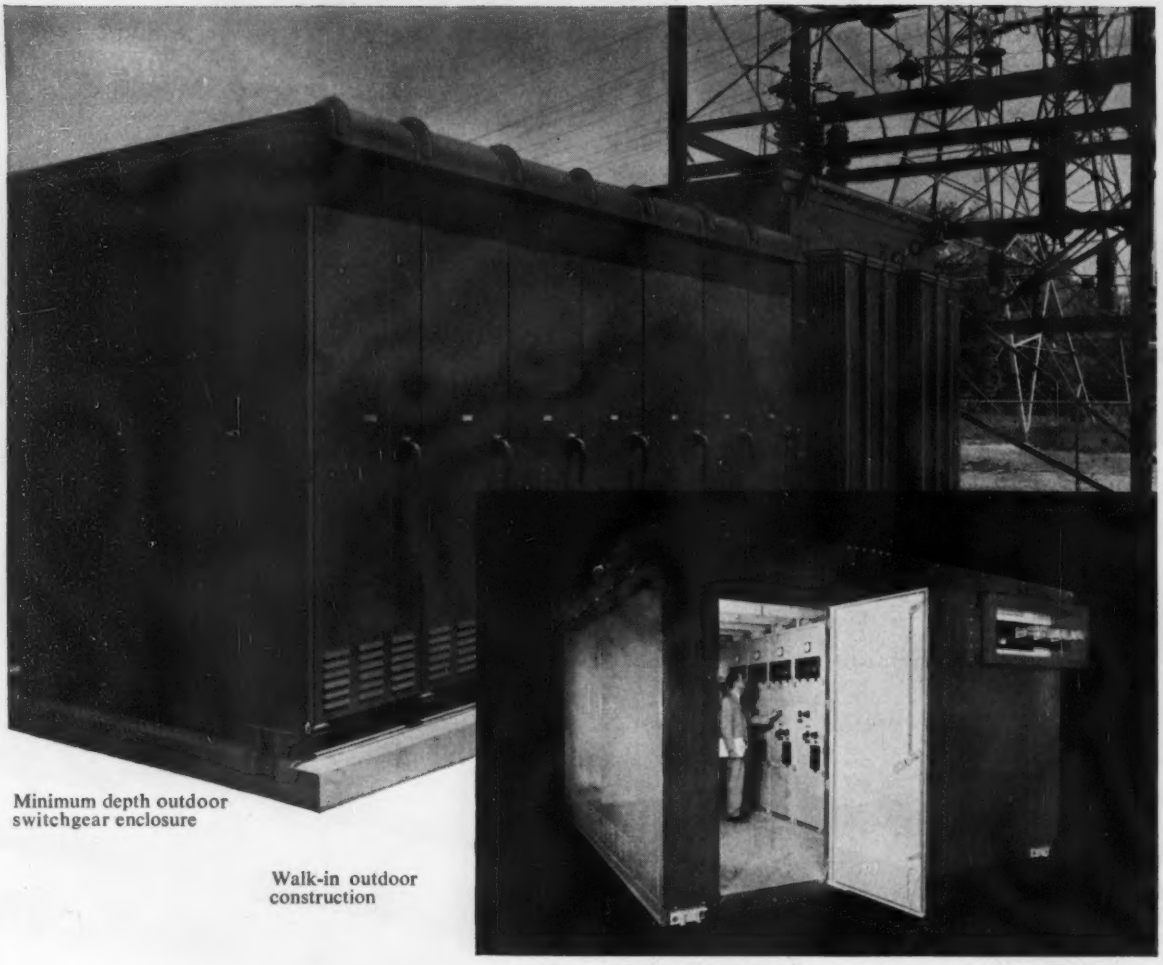
Rigid conduit in steel is the strongest answer to your electrical raceway problems. And that's proved by more than 50 years of dependable wiring protection.

Before you specify your next job, ask your electrical distributor for comparative details. Or check with leading manufacturers of steel electrical conduit, many of whom build their products from Bethlehem steel—EMT from Bethlehem steel sheet; rigid conduit from Bethlehem steel pipe.

Bethlehem Steel Company, Bethlehem, Pa. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



Minimum depth outdoor switchgear enclosure

Walk-in outdoor construction

All-new switchgear makes I-T-E primary unit substation better buy than ever

I-T-E custom designs your primary substation just for you—to meet your exact power, space and future expansion requirements—yet charges you nothing extra. This is just one of the ways that I-T-E gives you a better buy.

And now! I-T-E primary unit substations come with completely new HK switchgear as standard equipment. You get all the advantages of today's most advanced switchgear in outdoor equipment: new compactness, stored energy closing, new ease of access, and new safety for personnel. It's available in minimum depth outdoor enclosures for areas where space is limited, or outdoor walk-in construction for easy maintenance in bad weather. All doors and joints are completely gasketed. All parts are treated for rust resistance and painted prior to assembly.

I-T-E primary unit substations are available in all standard kva ratings and secondary voltages to 13.8 kv. Write for complete information. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Phila. 30, Pa.

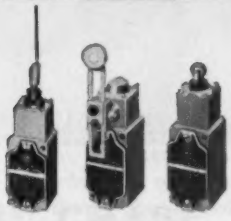
I-T-E CIRCUIT BREAKER COMPANY

AUTOMATION BEGINS HERE

. . . Insist on Allen-Bradley accessories for continuous automatic production

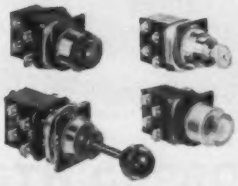
In this broad line of Allen-Bradley accessories, each and every unit carries the traditional A-B trademark of *quality* that stands for trouble free operation. Rugged construction, and maintenance free, silver alloy contacts provide the reliability that is essential to the continuous operation of your automatic production machines.

Profit from the experience of the leading machine tool builders . . . insist on Allen-Bradley *quality* motor control *all the way!*

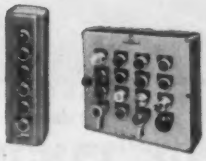


OILTIGHT LIMIT SWITCH
Bulletin 802T with sealed heads and bodies. Various operators.

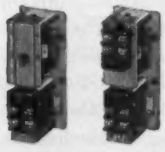
PRECISION LIMIT SWITCH
Bulletin 802 oiltight. Responds to very small operator travel.



OILTIGHT CONTROL UNITS
Bulletin 800T. Choice of push buttons, lights, and switches.

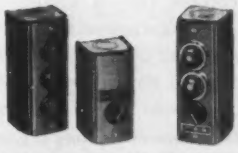


OILTIGHT CONTROL STATIONS
Bulletin 800T for up to 16 units in die cast aluminum enclosure.

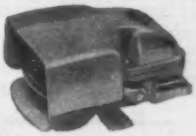


PNEUMATIC TIMERS
Bulletin 849. Reliable and accurate. For on-delay or off-delay.

OILTIGHT PRESSURE CONTROL
Bulletin 836. For hydraulic systems with pressures to 5000 psi.



STANDARD DUTY PUSH BUTTONS
Bulletin 800. Up to three units, also pilot lights and switches.



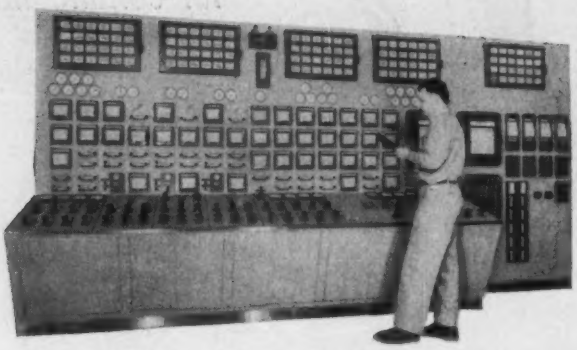
FOOT SWITCH
Bulletin 805. In rugged die cast housing for toughest service.

ALLEN-BRADLEY

Member of NEMA

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1327 S. First St., Milwaukee 4, Wisconsin. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



Foxboro control console . . . designed and built as a single unit — for Public Service of New Hampshire, Bow Station

a bold concept in central station instrumentation

Central station control room panels have looked pretty much the same in generating stations built in the past decade. Now, The Foxboro Company introduces a dramatic new concept in control room instrumentation.

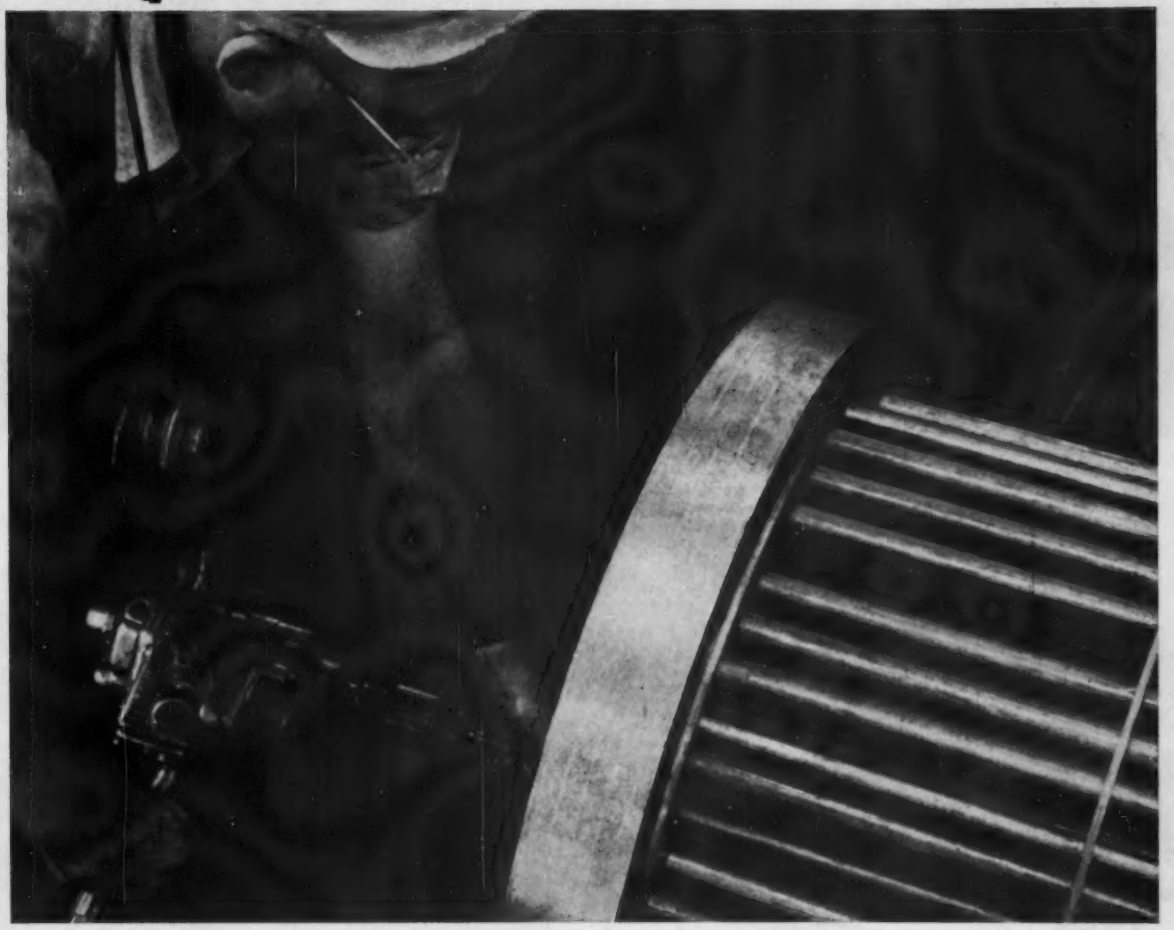
Called the "Consotrol Approach," the new system blends the separate instrument panel and the separate operator's console into a single, integrated operating unit. The expense of transmitting variables to the panel *and* to the console is eliminated; control room size is reduced; plant operation is simplified.

But what makes the new system really pay off is its use of small-case Consotrol* electronic and pneumatic recorder-controllers. These unique Foxboro instruments are so compact that *four* can be mounted in the panel space required for a single large-case recorder. Result: control panels which would normally run up to 50 feet in length, can now be erected in a fraction of the space — and at a fraction of the cost.

At a time when instrument outlay accounts for as much as 10% of new construction costs, the Foxboro Consotrol Approach is particularly worthy of close Industry investigation. For more complete details write The Foxboro Company, 249 Norfolk Street, Foxboro, Massachusetts. Ask for Bulletin 1-17.

Reg. U.S. Pat. Off.

Chase BRASS & COPPER CO. WATERBURY 20, CONN.
Subsidiary of Kennecott Copper Corporation



NOW! CHASE® HIGH STRENGTH CUPRO-NICKEL 30% PREHEATER TUBES—STRAIGHT AND U-BEND!

Strength of Nickel-Copper 65/35—at half the cost! Now you can save up to half of your costs for tube when you retube or buy a new high pressure preheater for your steam-generating plant! Reason is that Chase® has developed a new tube—High Strength Cupro-Nickel 30%—that has the strength of Nickel-Copper 65/35...*and costs only about half as much!*

Available as straight lengths or as U-Bends, this new alloy tube is designed to operate at 600° F., and in high pressure service. It meets ASTM Specification B-111, and has the tensile and elongation properties needed to form U-Bends without weakening.

For full details, ask for your copy of the new Chase folder on High Strength Cupro-Nickel 30%...at your nearest Chase warehouse, or write Chase at Waterbury 20, Connecticut.

THE NATION'S HEADQUARTERS FOR ALUMINUM • BRASS BRONZE • COPPER • STAINLESS STEEL AND FORGINGS

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis New Orleans New York-Newark Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

CHASE BRASS & COPPER CO.
DEPT. EW-9, WATERBURY 20, CONN.

Please send me your special folder on Cupro-Nickel 30% tube.

NAME_____

FIRM_____

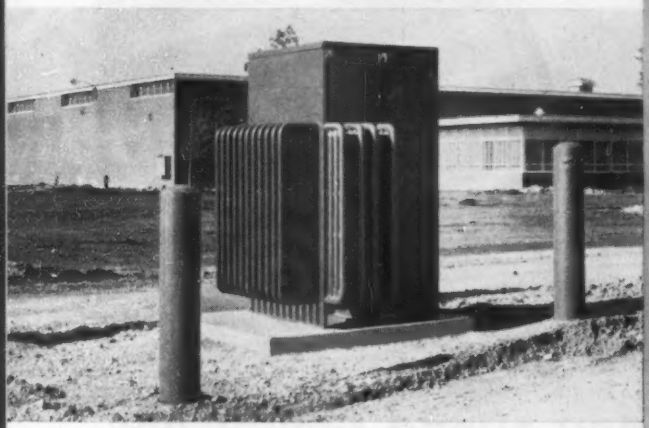
STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

You Be the Judge
Of Transformer Values

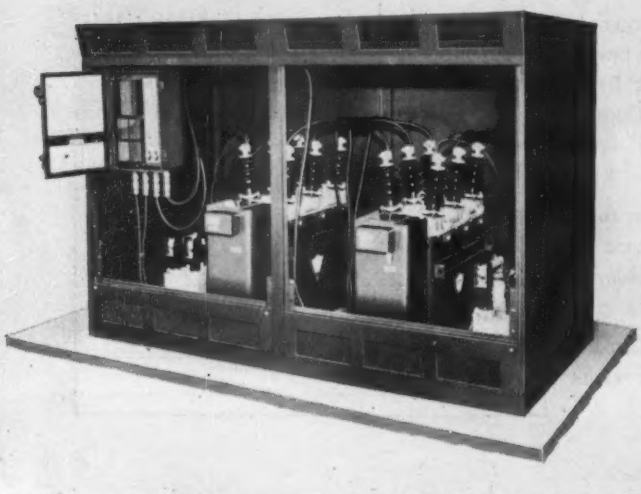
This three-phase, 500-kva, 120/208Y volt L-M Pad-Mount supplies underground service from a 13.2 kv delta primary to a shopping center area. Combining attractiveness with economy, the transformer facilitates metering of three loads from one location. Power consumed by a restaurant, an automatic 24-lane bowling alley, and an adjacent drive-in restaurant, is metered directly in the secondary compartment.

Two L-M Pad-Mounts supply power from a 13.2 kv primary to this all-electric drive-in theater. A 500-kva unit serves the concession and projection buildings, as well as the parking and exit lights. The 112-1/2-kva unit, shown here next to the businesss office, handles the office, ticket cages, marquee and entrance-way lighting. This L-M Pad-Mount is completely hidden when the decorative panel is locked in place.



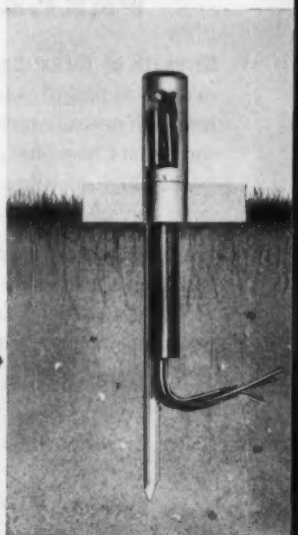
Underground service to a light manufacturing plant in a newly constructed industrial park is supplied, as shown here, by this 300-kva, 4 kv L-M Pad-Mount.

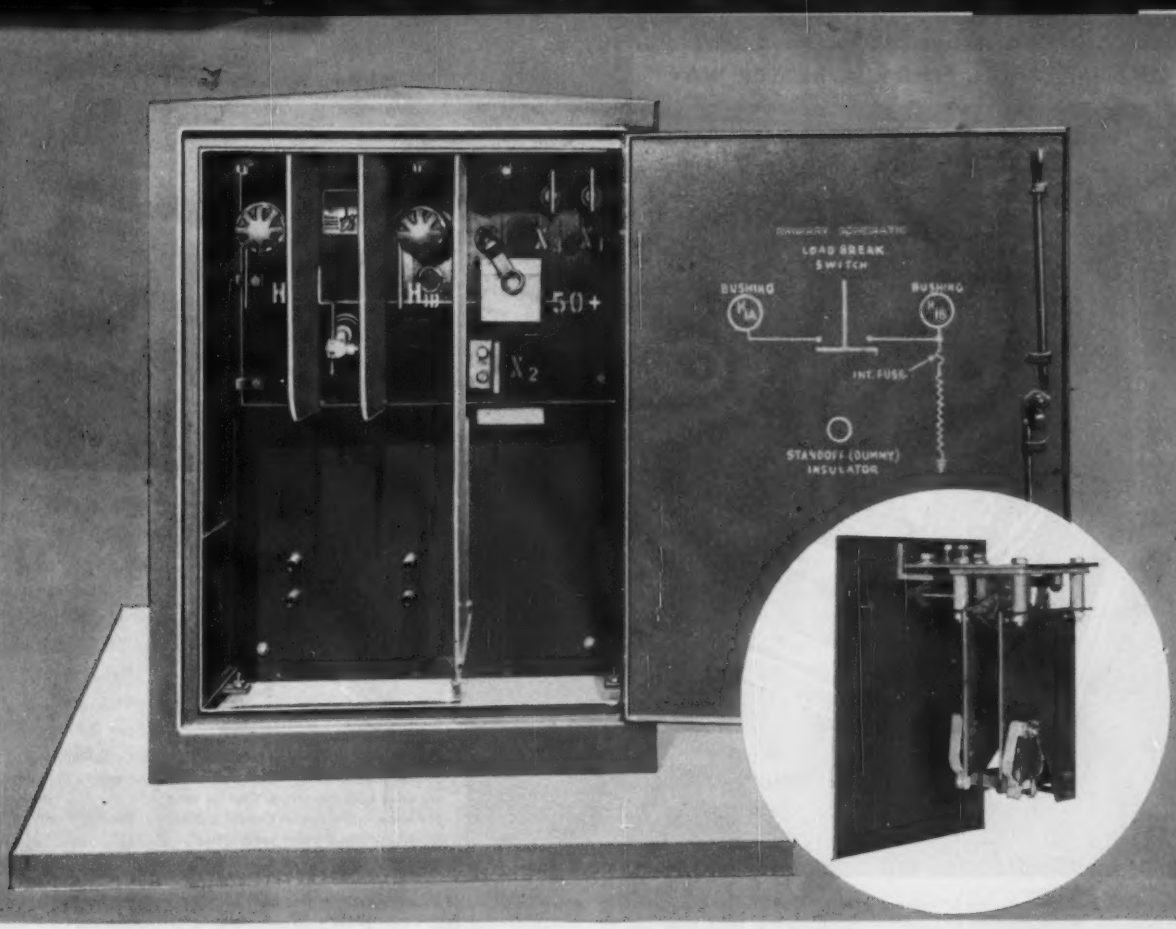
Here a single-phase, 25-kva, 120/240 volt L-M Pad-Mount (can you find it?) supplies power from a 7.2 kv primary to five heavily electrified homes in this beautifully landscaped high-income residential area.



Another economic solution for cutting underground costs is the L-M Transclosure housing. Originally designed for either standard single or three-phase pole-type distribution transformers, it can also be used singly or ganged, as shown here, to provide as much space as is needed for switching and protective devices. Transclosure housings are well ventilated, but safely closed, with locked, tamper-proof steel door panels.

L-M Power Pedestals, used with L-M Pad-Mount Transformers and L-M Transclosure housings, provide rain-proof, tamper-proof facilities for above-ground connection of secondaries. Various types, including fusible, and terminal designs are available.





L-M 50-kva Pad-Mount Transformer. Primary section, left, has stand-off insulator at center, Type N Load break switch control above. Phenolic insulating barrier separates secondary compartment, at right, so that secondary compartment may be inspected, without danger of contact with high voltage. Available in single-phase to 167 kva; in three-phase to 500 kva

Type N Load Break Switch, an L-M exclusive; available on L-M Pad-Mount Transformers. Heavy duty mechanism with contacts operating under oil; convenient operating handle. Nominal load rating 200 amperes; 9000-amp. RMS asymmetrical momentary current rating; 4500-amp. one-second RMS symmetrical short-time current rating.

L-M Leads With Economical Equipment For Underground Distribution Systems

Designed with utility company cooperation, L-M's Pad-Mount Transformers, Transclosure housings, and other equipment provide practical aids for cutting costs of underground.

Line Material's leadership in underground equipment began years ago, with the development of a completely engineered system for underground fibre conduit. Since then, anticipating the mounting pressure for underground distribution, L-M has, over the years, developed a line of items that best met utilities' needs for practical, economical equipment.

Some of L-M's outstanding equipment:

Pad-Mount (TM) Transformers available in a variety of styles and ratings through 167-kva single-phase, 500-kva three-phase. Developed, like much of L-M's equipment, with the close cooperation of utility companies.

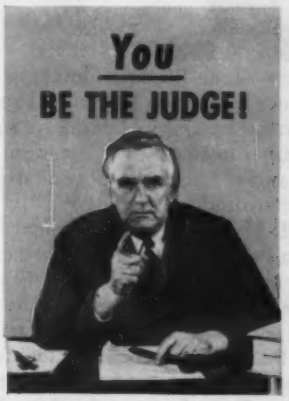
Transclosure (TM) housings available in seven sizes, for housing L-M Round-Wound® pole type transformers, switches, reclosers, control equipment for lighting systems, telephone equipment, etc. Units may be ganged. Well designed, with rainshed roof, tamper-proof ventilation, locked doors.

L-M Power Pedestal, a rainproof, tamper-proof device for terminating and connecting secondaries above ground. Designs include fusible and terminal types.

L-M Permaline Fibre Conduit and materials for all duct system requirements.

Get Complete Information

L-M Field Engineers and Apparatus Specialists can give you complete information about L-M equipment, and a good deal of helpful information about underground installations. Ask the L-M Field Engineer who calls on you; or write Line Material Industries, Milwaukee 1, Wisconsin.



LINE MATERIAL® Industries
McGRAW-EDISON COMPANY
Distribution Transformers

DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES
FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE AND CONDUIT

LINE MATERIAL FINDS "A BETTER WAY"

Close-up of Peltier thermoelectric device. Spring tension on the heat pumps automatically adjusts the device to different lamp bulb diameters. Can be used with any T12 through T17 lamp. L-M's Peltier device is presently available only for 6-foot, 4-lamp shallow luminaires.

This six-foot, four-lamp shallow luminaire utilizes four L-M Peltier thermoelectric heat pumps for spot-cooling the fluorescent lamps. In the heat pump, direct current flows through a series of junctions of dissimilar metals, alternately absorbing heat in one junction and liberating heat in the other. The cold junctions contact approximately one-half square inch on the lamp bulb walls thereby maintaining the mercury vapor pressure within the lamps at the optimum value for maximum light output.

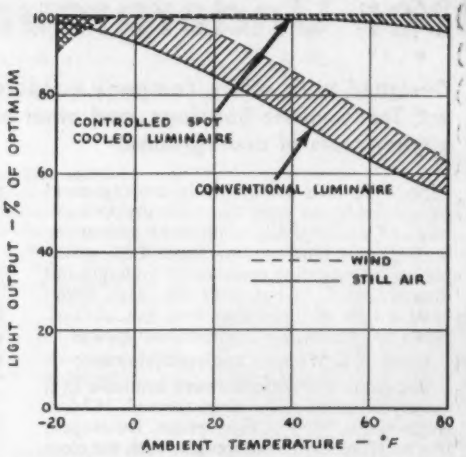
L-M's Revolutionary New Development Keeps Fluorescent Output at Maximum

by **STACY STANDLEY,**
Product Manager, Lighting
Line Material Industries

Now—Line Material develops another important engineering advance in outdoor lighting—Thermoelectrically Cooled Fluorescent Luminaires. These luminaires solve the basic problem of fluorescent lamp lumen output variation caused by ambient temperature changes. Another vital contribution by Line Material Industries to better outdoor lighting.

L-M Lighting Development Engineers have ingeniously adapted the Peltier thermoelectric principle to spot-cool fluorescent lamps. By the simple process of cooling a small area of each lamp, internal mercury pressure is held at the optimum and light output is maximized regardless of ambient temperature.

Be sure you get complete information on L-M's latest contribution. Contact your L-M Lighting Engineer, or write direct to Line Material Industries, Outdoor Lighting, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.



Performance curves of luminaires with and without controlled spot cooling: solid edge of band represents still-air conditions, dotted line represents 10 MPH of wind.

LINE MATERIAL® Industries Outdoor Lighting
McGRAW-EDISON COMPANY

McGRAW EDISON

DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES · FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING · LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE & CONDUIT

SEPTEMBER 12, 1960

Cornell EHV Cable Tests Begin

With the formal opening of the Cornell Extra High Voltage Cable Testing Station, this week, the electrical industry in the US is taking its first exploratory steps in EHV cable practice. At Cornell the groundwork will be laid for an upward movement in underground cable voltage matching the one already taking place on overhead lines.

The project, jointly sponsored by the Association of Edison Illuminating Companies and the Edison Electric Institute with the cooperation of manufacturers of high-voltage cable and accessories, marks a major step in electrical industry research.

The Cornell program involves field tests under actual field installation and operation conditions to evaluate the mechanical and thermal performance and measure the losses of cable and accessories designed for 345 kv and 500 Mva. It will take three years. The first two will be spent finding out whether present 345-kv cable designs are suitable for US power systems; the third to find the ultimate capability of underground cable systems.

The work will achieve two highly desirable ends. First, it will develop the engineering information necessary to apply EHV cables to major metropolitan power systems for underground getaway circuits from major power stations in congested areas and to carry EHV circuits through suburban areas and around large cities where overhead circuits cannot go. Second, and equally important, the test findings will produce engineering information on soil conductivity, cable thermal and dielectric losses and cable movement, for example, that will inevitably improve the quality and performance of medium-voltage cable now widely used on US power systems.

But the EHV cable field tests to be made at the new testing station are only a good beginning. The need for EHV cable research, development, and testing will certainly not end with this three-year program. Other problems will arise. It is to be hoped that the cable test station opening this week at Cornell may someday become a permanent, utility research center dedicated not only to the solution of high-voltage-cable problems but also to other areas of power system research and development.

Co-ops Take Step to Allay Criticism

We are heartened to see that rural electric cooperatives have begun in earnest to put their reserve funds in the new 2% government bonds issued for that purpose. As we reported (EW, Aug. 22, p 44) some 30 co-ops bought $1.2 million in the new bonds during the first month of issue.

Insofar as these 2% bonds are used to replace other forms of investment at higher interest rates, they should serve to curb criticism of at least one co-op fiscal practice. That is the practice of borrowing federal money at 2% and investing reserve funds in government securities at higher interest rates.

But if these bonds are used merely to discourage or replace advance payments on the Rural Electrification Administration loans, then the whole purpose of diverting criticism from the co-ops will be defeated.

We think that responsible co-op leaders have done themselves and other taxpayers a favor in asking for the 2% bond issue. We think the co-ops which are speedily making use of the bonds in lieu of other more profitable investments are carrying out the spirit of Congressional action.

It would seem only fair to us that all co-op investments be converted to the 2% bonds if the co-ops are to allay criticism that they borrow at 2% and invest at 4%.

PASNY Sets Rates for Industry

- **Vermont deciding how much Niagara power to ask for**
- **PASNY will not disclose what charges to industry will be**
- **Industrialists said to be pleased with terms proposed**

As questions of allocations and charges for power from the Niagara project are being resolved, the Vermont Public Service Commission has received a report showing that the state's preference agencies could save more than $1 million annually by 1972 by using Niagara power.

H. Zinder & Associates, in its report to the PUC, states: "Except for the early initial period, 1962 to 1972, all of such power and energy (2.9% of project capability) is needed for the most economic operation of Vermont's preference customers." Federal legislation authorizing the project requires that 10% of the power produced must be reserved for preference customers in neighboring states. For this reason, Zinder recommends that Vermont seek a reservation in terms of a fixed percentage of project output rather than a stated number of kilowatts and kilowatthours.

The report states that, as compared to the cost of power purchased from other sources at current rate levels, the purchase of firm Niagara power on a cost-of-service basis would save Vermont preference customers $332,000 annually in 1964 (the first year of full scheduled debt service), $1,201,000 annually by 1972 (when preference customers will have used their full reservation of firm power), and would reach $2,507,000 annually by 1993 (when the bonds would have been paid off). The savings thereafter would continue at this last level.

The report recommended that Vermont request not less than 2.9% and not more than 5.28% of all classes of energy and power from the project, based on the following compilations:

- By 1972 Vermont preference customers' firm energy requirements will be 310,000,000 kwhr at the project bus. The Niagara project will then be delivering about 10,700,000,000 kwhr of firm energy annually. On this basis a 2.9% reservation should be sought.
- Another approach estimated that Vermont preference customer power requirements by 1972 will be 94,976 of peaking capacity, which will then have a 1,800 Mw capability. On this basis Vermont should claim 5.28% of project capability, according to the report.

Estimated Total Annual Savings to Vermont Agencies Resulting from Purchase of Minimum Reservation of Niagara Power

Year	Niagara Power MWH Delivered to Vermont[1]	Niagara Power Net Cost At Vermont System[2]	Cost of Equivalent Power From[3] Steam Plant	Cost of Equivalent Power From[3] Additional Purchases	Savings of Niagara Power Over Equivalent Steam	Savings of Niagara Power Over Equivalent Purchases
1962.....	62,100	$370,316	$558,900	$643,356	$188,584	$273,040
1972.....	298,000	1,886,519	2,682,000	3,087,280	795,481	1,200,761
1975.....	300,000	1,834,491	2,700,000	3,108,000	865,509	1,273,509
1980.....	300,000	1,729,018	2,700,000	3,108,000	970,982	1,378,982
1985.....	300,000	1,629,374	2,700,000	3,108,000	1,070,626	1,478,626
1992.....	300,000	1,487,680	2,700,000	3,108,000	1,212,320	1,620,320

[1] Preference utilities' portion of firm energy at Vermont system (Firm energy at Project less 3.3 percent transmission losses)
[2] On cost-of-service basis after disposal of secondary energy at 2.0 mills per kilowatt hour
[3] Computed at average rate for energy of 9.00 mills for steam and 10.36 mills for other purchases all at same load factor as Niagara firm power (67.9%)

Meanwhile, preliminary rates have been set by the Power Authority of the State of New York (PASNY) for allocation of project power to industrial companies on the Niagara frontier.

The rates apply to 250 Mw to be allocated by PASNY itself for Niagara Falls industrial expansion and to 445 Mw to be sold to Niagara Mohawk Power Corp for allocation to Niagara Falls and Buffalo industry, which has been power hungry since collapse of the Schollkopf plant.

PASNY spokesmen refused to disclose the rates, reportedly favorable to industry, because final charges are subject to public hearings, the approval of the governor, and contract agreements between PASNY and the individual companies.

Transmission Charge Not Definite

The basic rate industry will pay for the new power was established several months ago. However, transmission charges to be added to the basic rate are still only a preliminary figure. A PASNY spokesman said charges will be uniform whether the power is for plants in Niagara Falls, Buffalo, or elsewhere on the Niagara frontier.

The preliminary figures were presented to representatives of Niagara Falls industry at a recent meeting. A PASNY spokesman said that people who attended the meeting with Niagara Falls industrialists "were quite pleased with what they heard."

Earlier, PASNY approved allocation of 325 Mw for rural electric cooperatives and municipal systems within the combined marketing area of the Niagara and St. Lawrence power projects.

This allocation formula, effective through 1984, gives 235 Mw to Niagara market municipals, 10 Mw to Niagara cooperatives, 70 Mw to St. Lawrence market municipals, and 10 Mw to St. Lawrence cooperatives.

E. Vere Stalcup, director of power utilization for PASNY, said 25 municipalities in the Niagara market area are eligible to purchase this power.

US, Canadian Columbia River Accord Foreseen

Signing of politically important treaty is expected to take place following provincial elections

Agreement between United States and Canadian negotiators, leading toward a treaty for development of the Canadian section of the Columbia River, may be reached at a meeting scheduled for later this month. The date for the meeting hasn't been set, but it's expected to take place after the provincial elections for parliament in British Columbia, Sept. 12.

Considerable disagreement between the two nations—and between Canadian provincial and national governments—had been apparent a month ago (EW, Aug. 15, p 60), but all parties now are believed to be near accord.

Reportedly, both the US and Canadian administrations are anxious to conclude a treaty on the Columbia as soon as possible in order to bolster their political standings before important fall elections on both sides of the border.

The coming meeting, between US and Canadian negotiators, is expected to result in sufficient agreement that a tentative treaty could be drafted afterward, to be reviewed and possibly ratified by the two governments. Almost certainly, the two negotiating teams will issue an important "progress report" after the meeting has ended.

Meetings between the two negotiating teams began last February, after the International Joint Commission issued its recommended "principles" for development of water and power potential on the Canadian section of the Columbia River (EW, Jan. 4, p 26).

Members of the US negotiating team are: Interior Undersecretary Elmer Bennett, team chairman; Major General Emerson Itschner, chief of Engineers; Ivan B. White, State Department official.

Mexico Disclosed as Mexlight Purchaser

A translucent cloak of mystery was removed from the sale of Mexican Light & Power Co Sept. 1 as President Adolfo Lopez Mateos of Mexico dramatically announced to a cheering Congress that the government had acquired control of the utility.

Financial and electrical industry pundits had Mexico pegged as the buyer for months (EW, June 27, p 38), despite the comic opera machinations Mateos had arranged to keep the purchase secret. Reasons for the complicated cloak-and-dagger purchase of stock from Sofina (Belgium) through various banks and other financial institutions all over the world still remain a mystery.

Mateos said 90% of the utility was purchased for $52 million, though it has a net worth of some $270 million. Mexico used $100 million loaned by the Prudential Life Insurance Co for this purchase and the earlier purchase of American & Foreign Power Co's properties.

Mexico takes the utility over officially Sept. 27, the day after Mexlight's board meeting in Toronto, ". . . fulfilling all the legal extremes."

In making his announcement, the president said he would propose "constitutional reform that the nation will be the only proprietor of a vital source of electric energy for its future development."

This means that the government will have control of all sources of energy including Pemex Oil Co and most electricity. Coal is expected to be the next energy source to come under government control.

Mateos said the government has put 12 generating stations in operation this year, with the biggest plant going in at El Temascal (77 Mw.) New plants are under construction at El Infiernillo, Michoacan, and Guerrero states. These plus others, total 1.8 million kw installed.

IUE Rejects Manufacturers' Proposals

Separate labor contract proposals made by General Electric Co and Westinghouse Electric Corp to the International Union of Electrical Workers (IUE) brought a single reaction. They were rejected. Contracts expire in October.

What appears to be a major point of contention is the dropping of the cost-of-living escalator clause by both manufacturers.

Similarities between the two offers include a job opportunity plan that would allow employees with three or more years of service to accept retraining and reassignment opportunities. Those eligible would be selected by management, and would be paid 95% of their daywork or salary rate during the retraining period. The union wants the workers to be selected on a seniority basis, and has objections to the pay.

Both proposals offer layoff income equal to one week's pay for each year of service for those who have been with the companies three years or more. Employees would have three options. They could: (1) Draw a lump sum after the layoff and seek employment elsewhere; (2) Use part or all of the money for outside schooling tuition to learn new skills; or, (3) Collect weekly income of 50% of normal pay, so long as he remains employed, for that part of the 12-month period after layoff that exceeds the maximum duration of state employment benefits. After 12 months of layoff, the employee would be free to draw out the unused portion in a lump sum.

Nez Perce-Mountain Sheep Testimony

Claims, counter-claims, predictions and statistical data "a foot thick" were filed last week by rival applicants for the huge, conflicting, controversial Nez Perce and High Mountain Sheep power projects on the Snake River.

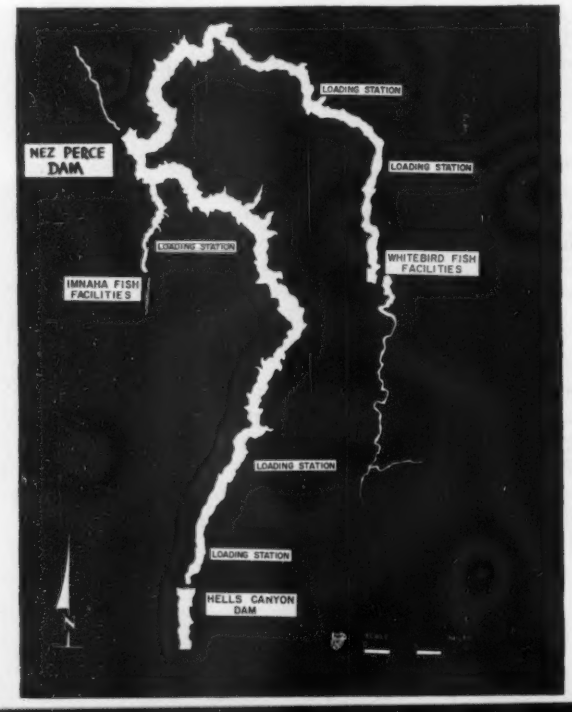
This filing of direct testimony by Pacific Northwest Power Co and Washington Public Power Supply System, Sept. 2, officially launched the two rival power plans on their legal path through the Federal Power Commission.

Both applicants in the Nez Perce-Mountain Sheep case are claiming their projects to be most economical per kw or in benefit-to-cost ratio. And both applicants include in their plans and claims a number of facilities which are not included in their immediate license applications. For example, Nez Perce proponents include no transmission line costs, on the expectation that Bonneville Power Administration will build the needed lines for them; and a small power development at the White Bird site on the Salmon River is mentioned in their application, but not specified in immediate plans, cost or engineering data. Also, High Mountain Sheep backers judge Nez Perce against High Mountain Sheep and Lower Canyon dams together, although they don't include Lower Canyon in the present application.

HIGH MOUNTAIN SHEEP DAM

Board Chairman Kinsey Robinson of PNP and Washington Water Power Co calls the project "Superior in every respect to the Nez Perce plan . . . (it will) provide the greatest benefit to the area . . . the High Mountain Sheep plan (including Lower Canyon) is significantly more economical, and will give the region cheaper power than the Nez Perce plan."

Map shows Nez Perce fish-handling proposal



Robinson adds that, "While the company has no plans or proposals to build the Lower Canyon dam, the designs and plans for that project are included in this proceeding because the development of the Salmon River for power and flood control must be considered by the Federal Power Commission under the Federal Power Act, and the applicant must show what that potential might be."

High Mountain Sheep power would be sold: 35% to Portland General Electric Co, 30% to Pacific Power & Light Co, 20% to Washington Water Power Co, 15% to Montana Power Co.

Vice President Arthur J. Porter of PGE testified that the four member companies of PNP will have a total load of 3,118,000 kw in 1967-68, and "At that time, the earliest High Mountain Sheep could be in full initial production, the combined firm energy deficiencies of the organizing companies will be 920,000 kw. The organizing companies of PNP have need of the entire output of High Mountain Sheep."

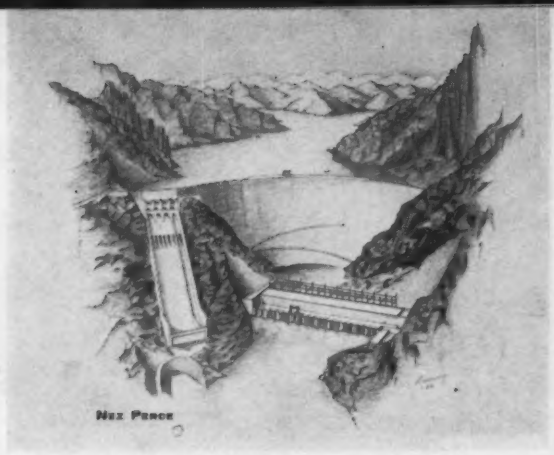
"Bonds and equity securities needed to finance the $257.1-million High Mountain Sheep project will be readily marketable," testified Albert H. Gordon, senior partner of Kidder, Peabody & Co. He estimated that the bonds, if sold on the present market, would have an effective interest rate of 4.8 to 5%.

Vice President Marshall Blair of WWP said the dam would require $66.2 million in transmission line construction, and would use one 345-kv and five 230-kv lines out of High Mountain Sheep. The 345-kv line would go to the Portland area, while the 230-kv lines would be divided: three to a Lewiston, Ida., switchyard, one between Lewiston and Spokane, one between Lewiston and Idaho Power's Brownlee Dam on the Snake River. The Lewiston-Spokane line has been built by WWP, and one of the three lines between Lewiston and the project area was energized in August —part of the Northwest grid interconnection with Brownlee.

A. E. Alspaugh, senior hydroelectric development engineer for PP&L, testified that the High Mountain Sheep plan (including Lower Canyon) "exceeds the Nez Perce plan at the maximum point by 255,000 kw of maximum capability, 195,000 kw of peak capability, 176,000 kw of average prime energy and 73,900 kw of average annual energy. The cost of power is approximately 10% cheaper from the High Mountain Sheep plan than from the Nez Perce plan. Cost of prime energy from the High Mountain Sheep plan is $293 per kw, against $323 per kw for the Nez Perce plan, or $30 less per kw. The benefit-to-cost ratio of the High Mountain Sheep plan is 3.22-to-1, against 3.11-to-1 for the Nez Perce plan."

The High Mountain Sheep plan "has greater power potential because of the excess gained by developing

Presented



Artist's sketch of Nez Perce shows arch dam

more head on the Salmon through the lack of restriction on raising Lower Canyon to a higher elevation than either High Mountain Sheep or Nez Perce," Alspaugh also said. "And, because storage is placed in two different reservoirs, more efficient utilization is permitted."

The safety of the proposed Nez Perce project was challenged by Charles C. Bonin, engineering manager for Ebasco Services, Inc. Bonin pointed out that "Numerous small, steeply dipping faults are common to the (Nez Perce) site. Where the dam abuts the narrow nose of rock on the right bank, considerable doubt exists as to its soundness and safety because of the adverse dip on the 'bedding planes' toward the river. Because of the uncertainties regarding the quality of the rock, it is recommended that a gravity dam would be a more prudent choice than an arch . . ." (It should be noted that WPPSS has moved its Nez Perce site about 500 ft downriver already, from the original Corps of Engineers site, to avoid a more serious fault zone. Owen Hurd, WPPSS general manager, however, claims that the new site has been fully studied, and a larger arch dam is feasible.)

Fish problems can be solved easily at High Mountain Sheep, testified J. A. Roy Hamilton, PP&L biologist. "High Mountain Sheep will not add new fish maintenance problems to those already experienced for the Snake River runs now seeking spawning grounds above Hells Canyon where other dams are now in operation or under license," he said. But, "Based on present knowledge, the large runs utilizing the Salmon River could not be preserved if either Nez Perce or Lower Canyon are constructed . . . Nez Perce presents problems more complex than Lower Canyon or High Mountain Sheep. At Nez Perce **(1)** The numbers of fish to be provided for are increased to the maximum—nearly 265,000 fish; **(2)** The same lack of an answer as to how how to handle downstream Salmon River migrants; and **(3)** The fact that three rivers—the Salmon, the Snake and the Imnaha—would be joining just above the Nez Perce dam site, presents serious problems of complicated thermal and flow characteristics in such a three-pronged reservoir. The biological implications are such that research could not resolve them. The true complexity and the full effect of fish life could not be realized until after Nez Perce was built, and that would be too late . . ."

NEZ PERCE PROJECT

Robert B. Gallup, principal engineer for R. W. Beck & Associates, Seattle, testified that the Pacific Northwest area will have an energy deficiency of about 1.3 million kw in 1966-67. Nez Perce could reduce this (2.1 million kw initial capacity) to 300,000 kw in 1967-68, but the deficiency would rise again to 2 million kw in 1970-71.

Hurd stated "it has been determined that the amount of power available from the project will be in excess of the amount WPPSS members will desire to take and use at the time it becomes available," but he said this power would be sold, at cost (4.25 mills per kwhr) plus wheeling charges, to other preference users.

Structural safety of the project was assured by Vice President Arthur P. Geuss of Harza Engineering Co, Chicago: "The structures proposed for the Nez Perce project will be stable and safe . . . the foundations for the several structures of the Nez Perce project are adequate with proper and customary treatment to assure a safe and stable structure from a design standpoint."

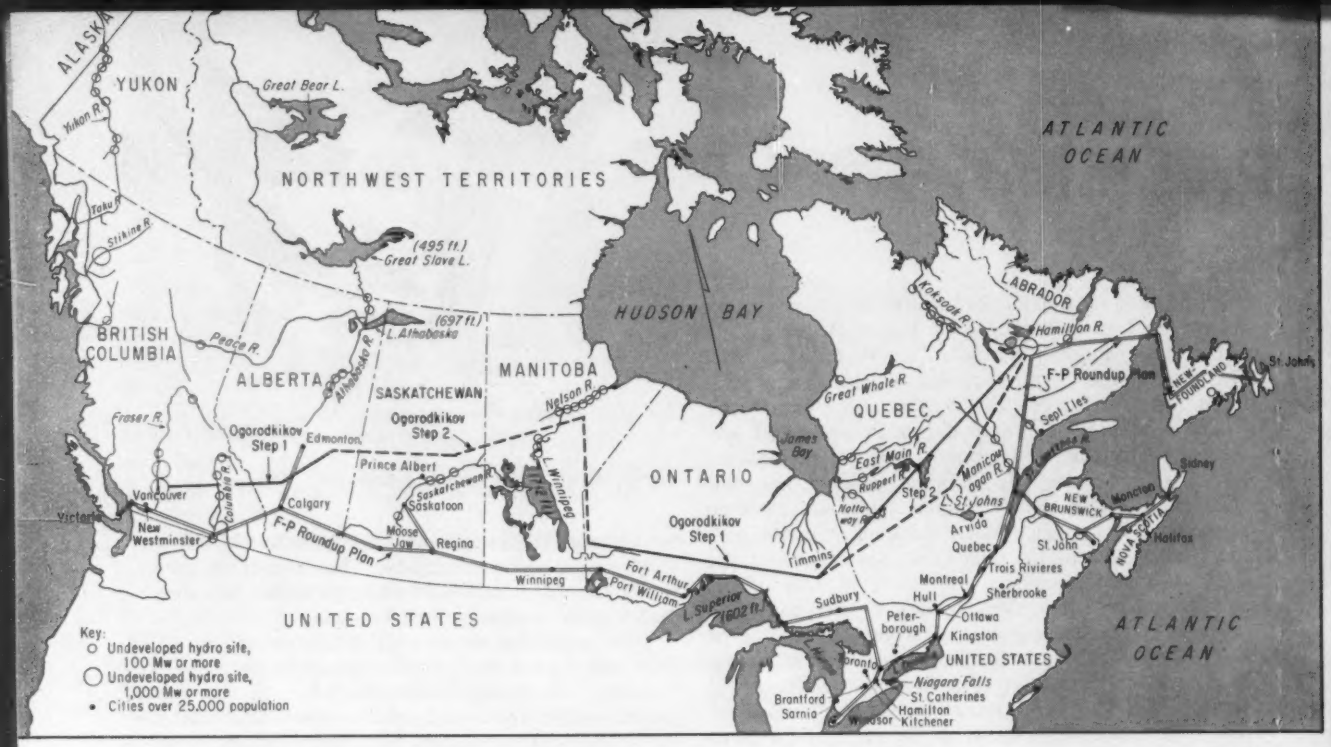
A Middle Snake development, using Nez Perce, Whitebird, Crevise, Freedom and China Gardens sites, would cost $755 million, while High Mountain Sheep and Lower Canyon, with Freedom, Crevice and China Gardens, would cost $840.5 million. "Annual charges for the first (Nez Perce) series of dams was estimated at $48,250,000 and $53,840,000 for the second (High Mountain Sheep-Lower Canyon)—a difference of $5,590,000. Comparable capacity of the first sequence of projects would be 2,855,000 kw and for the second, 2,820,000 kw—or 35,000 kw less.

An interest rate of between 4.5 and 4.75% was predicted by Townsend Wainwright, president of Wainwright & Ramsey, Inc, N. Y., for the $473-million revenue bonds that would be needed to finance Nez Perce.

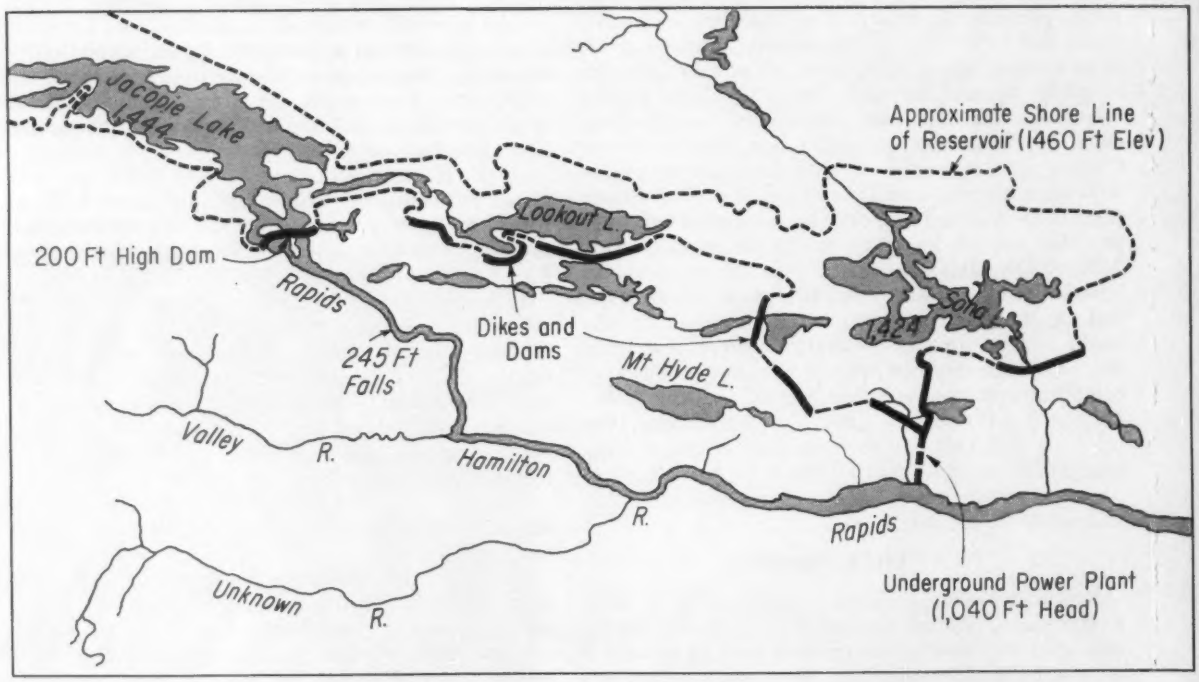
Fish facilities for Nez Perce are adequate for present construction, testified William R. Martin, Harza civil engineer: "In my opinion, the facilities for fish attraction, collection, passage, etc., are engineeringly and technically sound. All features . . . have been hydraulically and biologically tested and/or adequately proven in operation as to their capabilities, and therefore should function competently."

Another fisheries biological consultant, Harlan Holmes, also testified in favor of the Nez Perce plan's fish facilities.

The Nez Perce facilities—developed in remarkable speed—call for a 270-ft ladder for upstream migrants, plus entry into the dam about a third of the way up the reservoir through twin pressure locks. A "full river width" attraction device would head them toward the ladder. Downstream fingerlings would be trapped in a special louver system at the Whitebird site, then sorted, sized and barged over the dam by means of a helical chute. The louver design was found to be "97% efficient in tests at Tracy, Calif."



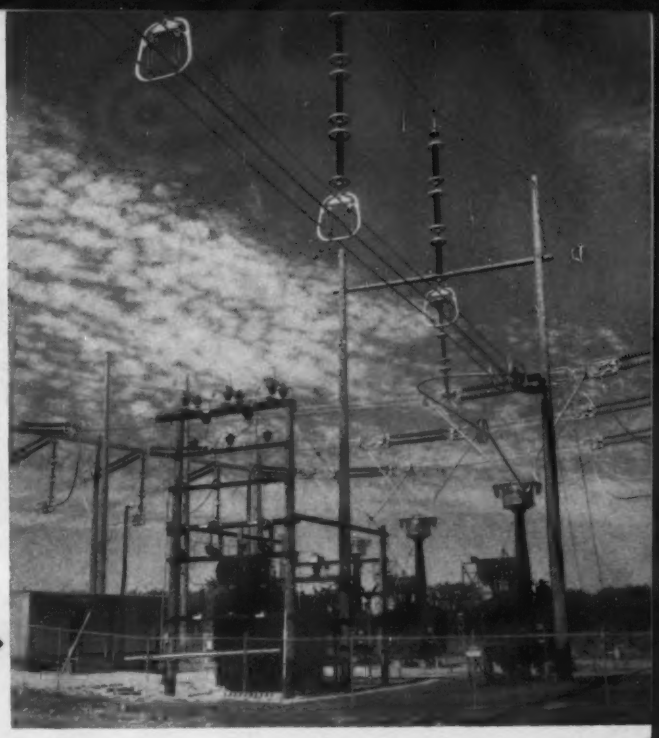
Canadian Utilities Plan



200-FT-HIGH DAM ABOVE HAMILTON FALLS and 16 miles of dikes and smaller dams will form reservoir with 1,040-ft head on underground site capable of 3,200-Mw ultimate

LEN OLMSTED IN CANADA—II

Remote hydro sites in Labrador and British Columbia offer multi-million-kw potential, spur urgent drive to boost EHV voltages and develop dc transmission



ROUTES PROPOSED FOR COAST-TO-COAST INTERCONNECTION would pool remote hydro sites to serve Canada's population centers, gaining cheap surplus power and diversity on individual system peaks

COLDWATER TEST LINES help Ontario Hydro develop design for 460-kv transmission to develop remote hydro sites near James Bay

Big Plants, Transcontinental Grid

Big hydro projects, higher transmission voltage, coast-to-coast interconnections, and a determined drive to maintain the growth rate of electrical loads are prominent in the planning of eastern Canada. Meanwhile Ontario Hydro, facing the end of economical hydro sites within reasonable reach, has broken ground for an 1,800-Mw coal-burning steam plant and joined with Atomic Energy of Canada to build the 200-eMw Canadian Deuterium Reactor (CANDU) plant.

Hydro, the source of 92% of Canada's electric energy, is the key to all this activity. According to Canadian Electrical Association's former president, N. S. Crerar, Canadian utilities must add an average of 3.5 million kw annually during this decade. Some of the more favorable developments are producing power at costs probably well under 2.0 mills because the published average cost of hydro power in southern Ontario is 2.5 to 3.0 mills per kwhr. Today, with the best sites already developed, the objective is production at less than the cost of fossil-fueled steam.

Under these circumstances, the availability of 4.7 million kw on Labrador's Hamilton River is spurring ambitious planning. This river, draining a 30,400-sq-mile watershed liberally studded with lakes at about 1,400 ft elevation, today plunges over a 245-ft falls and extensive rapids into a deep canyon in its rush to the sea. Blocking the Hamilton above the falls with a 200-ft-high dam will merge a number of lakes into one mammoth reservoir.

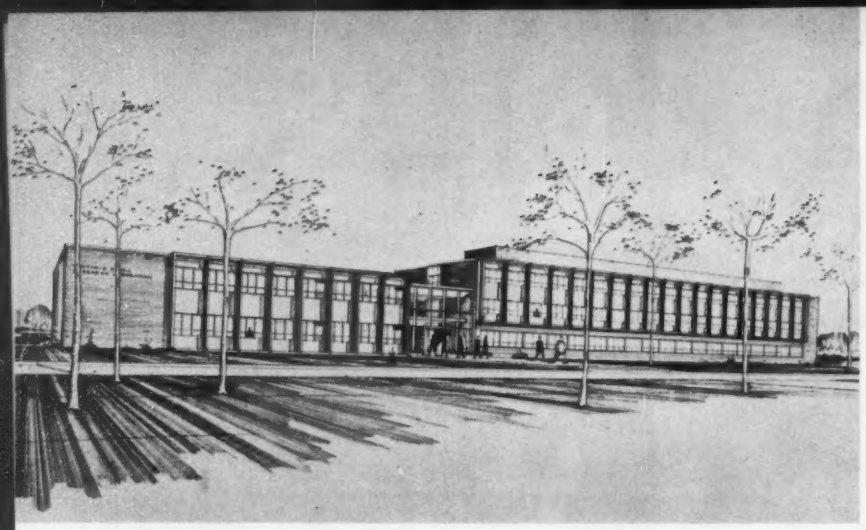
Plant Underground

Approximately 16 miles of dykes and dams will be required, but ultimate development will provide more than 10,000 sq mile feet of storage. Tunnels about 1.5 miles long will drop this water at 1,040-ft head through 200-Mw generating units in an underground plant into the canyon below the falls. Ultimate development at this site, with water augmented by diversion from the headwaters of several tributaries, will reach 3.2 million kw. And another site downstream can generate 1.5 million kw from the remaining 400-ft drop of the river.

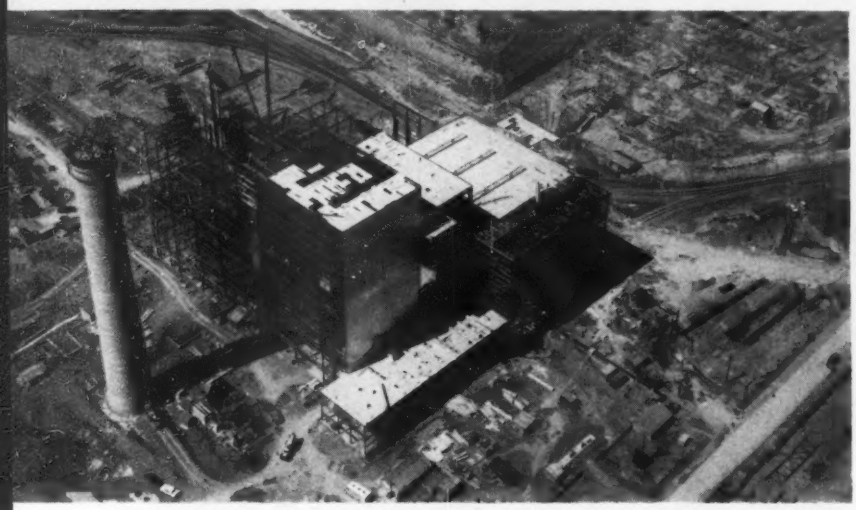
Initial development will be at Twin Falls on the Unknown River, a tributary, where Hamilton Falls Power Co (a subsidiary of British Newfoundland Corp) is installing two 45-Mw Francis units at 300-ft head to supply power by 1962 to two new iron mines at Wabush Lake 110 miles west. This site has a potential of 225 Mw but its water will ultimately be diverted for the big Hamilton River project.

Principal deterrent to the large-scale development is, of course, its remoteness from load. With 400-kv transmission to the St. Lawrence 250 miles south, it could serve a large industral load at about 3 mills per kwhr. But the closest existing large loads are 600 to 1,200 miles away, involving transmission on a scale which has not been attempted in the Western Hemisphere. This, coupled with apparent apathy in the Province of Quebec through which transmission would have to pass, probably sparked Newfoundland Premier Smallwood's alleged proposal that Russian engineers be ininvited to show Canada how to develop the Hamilton River.

But Canadian utility engineers have not overlooked the Hamilton's



NEW RESEARCH LABORATORY on 8-acre site in Ontario Hydro's Manby Service Center will house research staff of 300 persons



LAKEVIEW GENERATING STATION will roll its first 300-Mw unit next year. Ultimate development will provide 1,800-Mw capability

potential. A report by Ontario Hydro-Electric Power Commission's V. E. Ogorodkikov notes that Canada's hydro resources could be boosted 24 million hp (17.3 million kw) by extending EHV transmission to more remote sites. In this extension, he would also link existing systems with 1,000-Mw lines at 600-kv ac or 1,000-kv dc, thereby gaining capability by diversifying system peaks and by sharing system reserves. The first stage would link Ontario Hydro to the Hamilton River site and to the Manitoba system which is already interconnected with Saskatchewan. It would also link Alberta with British Columbia so that, with proposed ties completed between Saskatchewan and Alberta, an interconnection would be established from coast to coast.

The second stage of Ogorodkikov's plan would extend the 600-kv ac or 1,000-kv dc from Manitoba through Saskatchewan to Alberta to complete an EHV backbone 3,210 miles long. It would also add a second route from Ontario through Quebec to the Hamilton River. He estimates that $547 million spent for these transmission links and their terminal stations would save $1.9 billion of generating plant investments by individual systems, making hydro generation 1,000 miles away cheaper than thermal or nuclear generation at load centers.

A subsequent roundup by *Financial Post* found enthusiastic support for an EHV grid from the chairmen of three provincial power commissions and the general manager of a fourth. They were H. L. Keenleyside of British Columbia, David Cass-Beggs of Saskatchewan, D. M. Stephens of Manitoba, and J. S. Duncan of Toronto. The newspaper, in plotting its interpretation of their comments, extended the proposed grid westward to Victoria on Vancouver Island and eastward to Halifax and Sydney, Nova Scotia, and St. John's, Newfoundland. And their comments implied a strong preference for dc transmission, based upon Russian experience.

Meanwhile Canadian utilities extend their transmission at ever higher voltage to collect energy from more remote but desirable hydro sites. Quebec Hydro-Electric Commission, with 1,500 Mw recently on line at Bersimis I and II, has started to develop the Manicouagan River which flows into the St. Lawrence some 30 miles farther east. This river, with two rather large lakes of 645 and 740-ft elevation about 150-miles upstream, has sites for three hydro plants to produce 4,400 Mw. First power, scheduled for 1966, will be transmitted at 460 kv to Hydro-Quebec's Montreal load area farther than 400 miles southwest.

Plans 460-Kv Lines

Ontario Hydro also plans to use 460 kv transmission to bring power to Sudbury and southern Ontario from series of eight new plants in the Moose River watershed south of James Bay. First of these, at Otter Rapids on the Abitibi River, will produce about 170 Mw next year. Additional construction on the Mattagami River will develop nearly 500 Mw by the winter of 1966, to be carried 230 miles to Sudbury by one four-conductor-bundle circuit. Plans are to build a second 460-kv circuit when additional sites are developed, and to extend the 460-kv an additional 270 miles to Toronto.

Design of these 460-kv lines was based upon nearly a year of tests by Hydro's Research Division on test spans at Coldwater. And work in progress seeks to support the bundled conductors so that the upper pair will serve in lieu of grading rings around the hardware.

Hydro's Research Division's 300-

man staff next year will move into a new 160,000-sq-ft structure. Included in the new facility will be a high-voltage laboratory equipped for 60-cps tests up to 1,000 kv single phase to ground or 600 kv 3-phase and impulse tests to 1,500 kv. It will also have a 50,000-amp low-voltage source, vibration test spans, an anacusic room, X-ray and cobalt-60 facilities, as well as the more common mechanical, chemical, and spectrographic test equipment.

Among the investor-owned utilities of Quebec, the Aluminum Limited complex in the Saguenay River watershed will soon have on line the full 735 Mw of Chute-des-Passes. This plant has been blasted out of solid granite 450 ft underground astride a 6.5-mile tunnel passing the regulated flow of the Peribonka River. Its entire output will be boosted to 385 kv for transmission 91 miles via two steel tower lines to Saguenay Power Co at Isle Maligne and to Aluminum Co of Canada at Arvida. Surplus power from this complex, soon to have 2,630-Mw capability, will probably be sold to the neighboring Shawinigan Water & Power Co via a new 345-kv interconnection.

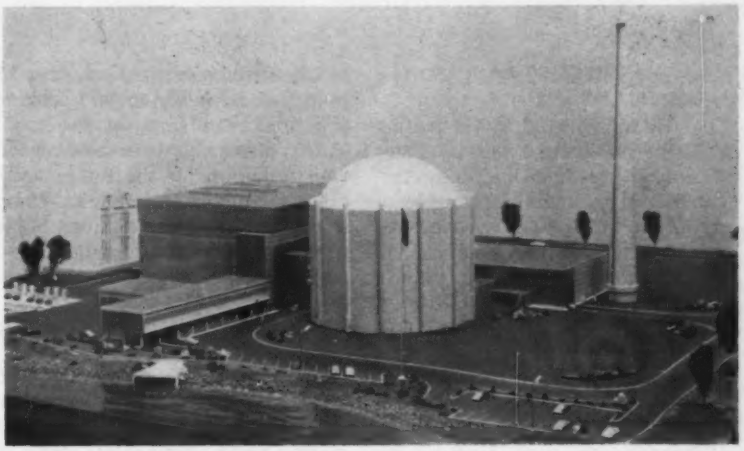
Makes Large Purchases

Both companies assume that Quebec's new Hydraulic Resources Minister Levesque will permit them to continue the development of the watersheds in which they are already established, despite a recent announcement that no new hydro concession of any size will be made to private interests. Aluminum Limited has an undeveloped 200-Mw site on the Peribonka between Chute-des-Passes and downstream plants and several storage reservoir sites on other tributaries of the Saguenay which could boost the firm capability of existing plants as much as 300 Mw. Thus, unless Alcan adds substantial aluminum load in the region, Sag Power has the potential capacity to serve foreseeable needs.

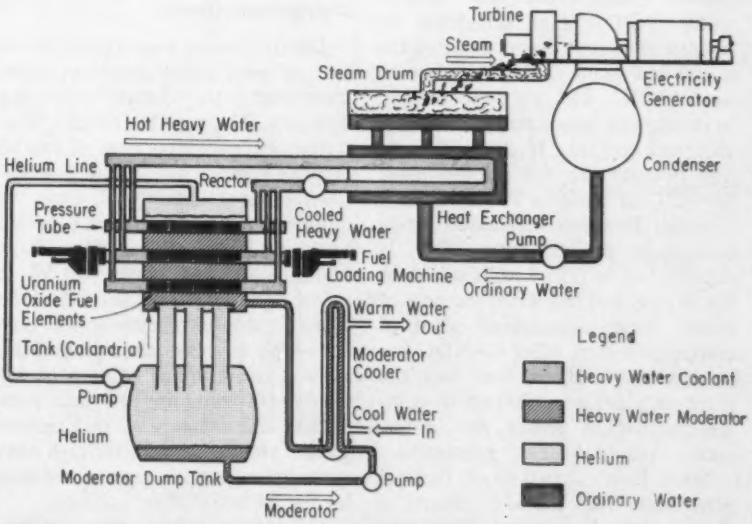
Shawinigan, on the other hand, serves 350,000 customers and already purchases large blocks of power to augment its 1,574 Mw of hydro generation. Remaining undeveloped sites in its St. Maurice River watershed offer only 323 Mw more capacity. Continued load growth could force the company to turn to coal-fired steam, a step for which it has already set up a Thermal Division in its engineering affiliate, or to nuclear power, capitalizing on its engineers' collaboration with Atomic Energy of Canada in several research facilities.

Gatineau Power Co, with over 500 Mw of hydro on the Gatineau and Ottawa rivers, is also buying power. But terminating or scaling down a large wholesale power contrast in the near future should leave Gatineau in good shape to serve its 100,000 customers.

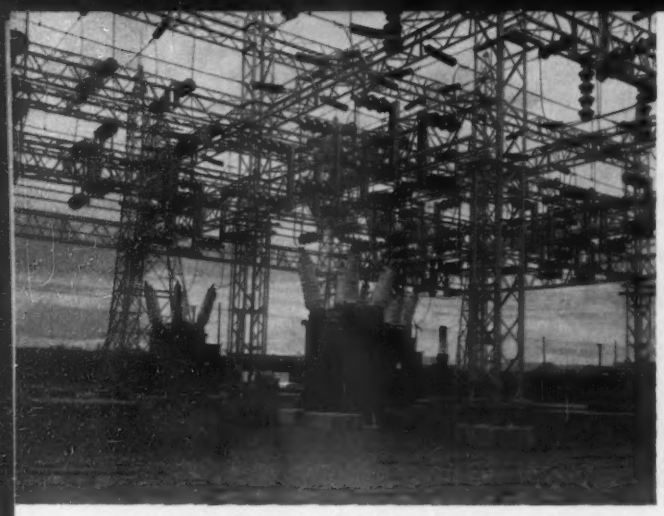
Ontario Hydro, meanwhile, has already adopted thermal generation as the solution to its soaring capacity needs. With Hearn Station at Toronto scheduled to reach 1,200-Mw capability this year, Hydro has moved to a new site just west of metropolitan Toronto for its next plant. Here it plans to roll a 300-Mw, 2,350 psi, 1,000/1,000F, coal-fired, cross-compound unit before the end of 1961. A duplicate unit will roll in 1962. The third and fourth units of similar capability but tandem compound to drive single generators, are scheduled for 1963 and 1964. Additional units are contemplated for subsequent years until



CANDU NUCLEAR POWER PLANT, under construction for Atomic Energy of Canada, will put 200 Mw into Ontario's system by 1965



CANDU'S DESIGN AND OPERATION will be based upon 20-Mw NPD. It features continuous fueling of natural uranium with heavy water coolant



CHARLAND'S 120-KV SWITCHYARD has ultimate of 200 Mva in transformers and five 120-kv lines on a ring bus

RELAYS FOR THE 120-KV YARD, together with those of the 12-kv and 4-kv structures, are racked in small control house

Lakeview Station reaches 1,800-Mw capability.

At Ft. William, Hydro is putting in a 100-Mw thermal unit to bolster its isolated western Ontario system. Thunder Bay Station is capable of expansion to 1,000 Mw. And yet another site has been acquired, in anticipation of boosting the system's thermal capacity to 8,000 Mw by 1980.

In these circumstances, nuclear power holds real attraction for Ontario Hydro, particularly as it would consume Canadian uranium in lieu of Pennsylvania coal. Hydro, with confidence bolstered by cooperation with Atomic Energy of Canada and Canadian General Electric in the 20-Mw natural-uranium heavy-water (NPD) plant scheduled to operate next year, has contracted for a 200-Mw plant. This plant, known as CANDU, will also use natural uranium with heavy water as moderator and coolant. Hydro will build and operate the $60-million plant for AEC at Douglas Point on Lake Huron. Power cost, based upon technology derived from NPD, is expected to be 6 to 7 mills per kwhr but Hydro will buy it for the cost of power from a coal-fired plant of comparable size. After CANDU has proved itself, Hydro will buy the plant at a price calculated to compensate for its power cost differential over coal-fueled generation.

Such heavy infusion of thermal generation has already caused a change in hydro design philosophy. Ontario Hydro, with a system load factor of about 65%, is mapping its Moose River watershed plans for 35 to 40% load factor to gain peaking capacity. And some of its recent hydro plants have been designed with provision for the future addition of peaking generation. Pump storage is further in the future, but is receiving some consideration as a means of matching nuclear generation to system load factor.

Several Quebec utilities face the peaking problem from the alternative approach of promoting load which can be curtailed during system peaks. Extensive use is made of electric boilers for process steam in pulp and paper mills, which can be operated on curtailable power at a cost below that of fuel-fired boilers.

Distribution Grows

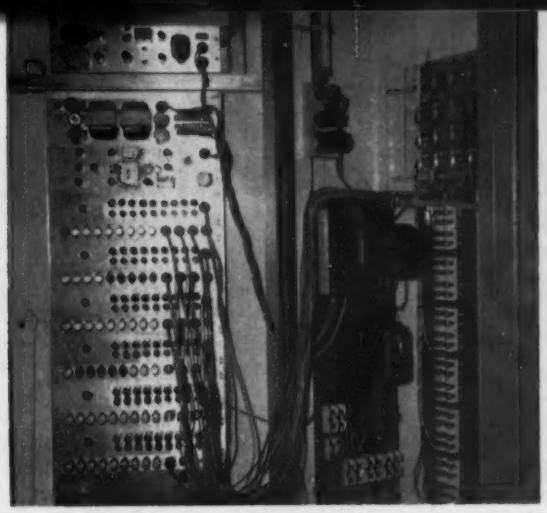
Distribution in and around Montreal is undergoing extensive reinforcement to handle soaring demands. The new Dorchester Substation, beneath a parking lot behind Hydro Quebec's new 24-story downtown office building, will have ¼ million kva of transformers supplied by four 120-kv cables. The 150 x 250-fgt area, excavated to 50 ft below street level, will also house the 120-kv cable terminations and outdoor-type air-blast circuit breakers, as well as terminal equipment for nearly 100 outgoing 12 and 4-kv feeders. The losses of this underground substation will, through heat exchangers, provide most of the heat for the 24-story office building.

Substations in less congested sections of Hydro-Quebec's Montreal service area are of more conventional construction. Charland, which will become one of two terminal stations for 610 Mw from Carrillon hydro station on the Ottawa River about 40 miles west, is also of ¼-million-kva ultimate capacity.

The initial installation provides an outdoor ring bus with round-tank oil circuit breakers connecting two 120-kv overload lines to three 33.3-Mva 120-12-kv power transformers. Each of two power transformers supplies an isolated 12-kv main bus, tied through 2,000-amp 3% reactors to the third power transformer. Ten 12-kv circuits radiate from each of two bus sections, each circuit having air break switches to a transfer bus controlled by its own oil circuit breaker. Isolation, plus extensive use of reactors, holds fault currents throughout the 12-kv switchyard within the capability of 1,000-Mva oil circuit breakers.

Six of the 12-kv circuits run underground to 5-Mva 12-4.33-kv transformers bused in groups of three on two sections of indoor double bus. Transformer connections and 14 outgoing feeder-regulated 4.33-kv circuits are switched by 600-Mva air-blast breakers.

Ultimate expansion of Charland Substation anticipates five 120-kv supply lines, connections to the 60-kv system, six 33.3-Mva power transformers, and six 12-kv bus sections. Metering and control for the entire station is comfortably housed in a 22 x 34-ft room. All relays for the 120-kv, 12-kv, and 4-kv equipment are racked nine rows high in a slightly smaller room. This compact-



CONTROL CONSOLE AT CHARLAND collects relay indications and supervisory data for tone-shift transmission

CONTROL CONSOLE AT JEANNE D'ARC converts supervisory tones to operating data, for switching

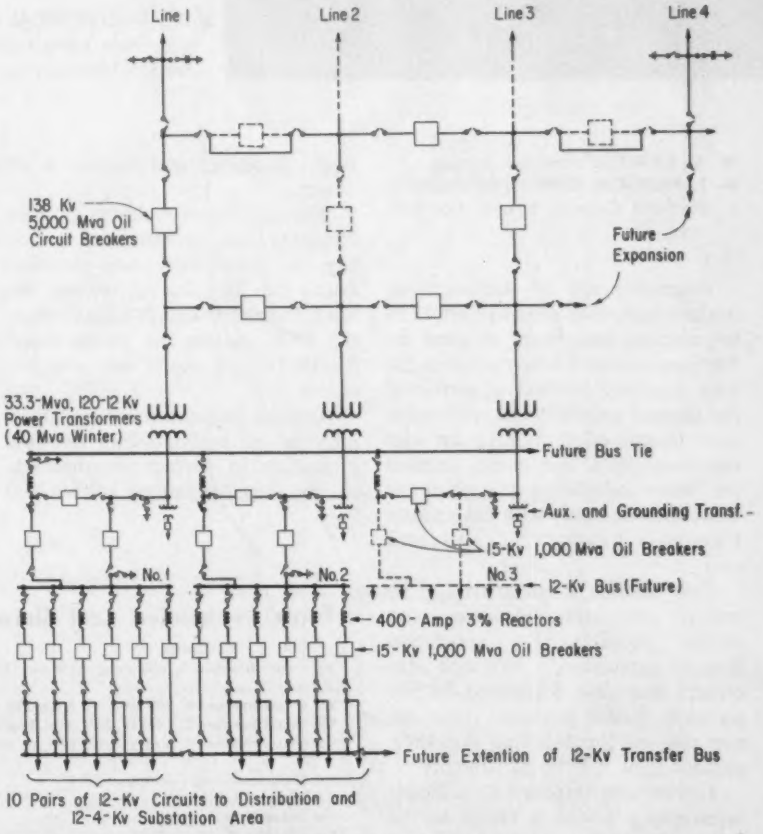
ness results from use of miniature control consoles, automatic data scanning and logging, telemetering, and supervisory equipment installed to control Charland's operation, together with up to 30 other substations, from a new master center under construction at Jeanne d' Arc Substation 6 miles away.

Gas Strong Competitor

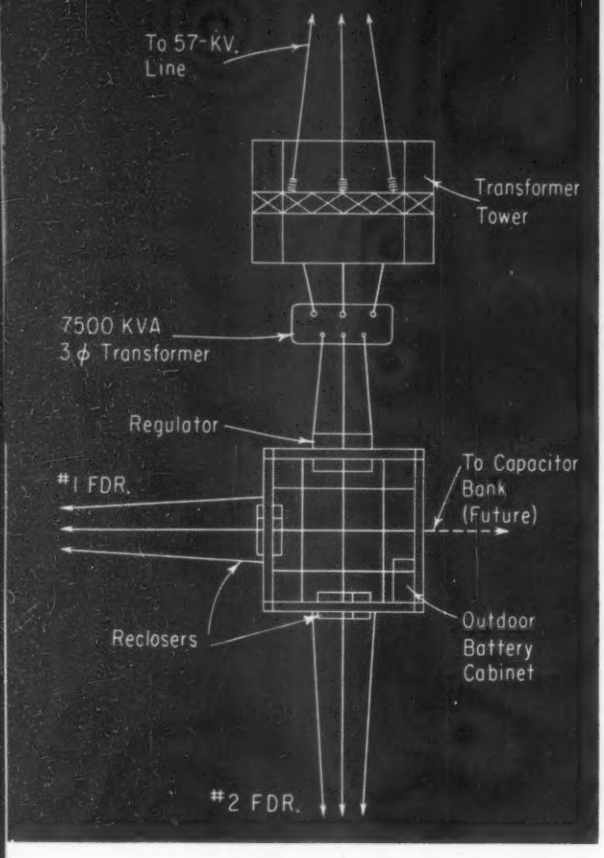
Prototype for the new supervisory system is already in service at one end of Fleury Substation's conventionally-sized control room. Here the regular station operator handles Fleury's local equipment while another operator at the supervisory consoles controls 16 other substations. The new tone-shift system scans breaker positions, transformer temperatures, and air-blast breaker tank pressures, by synchronous electronic switching over a single pair. It checks itself for continuity every second, sounds an alarm for scanning failure, and prints out every operation automatically. A second pair will give supervisory control of switching. Additional pairs telemeter voltage, current, power flow, and reactive flow of all lines and transformers.

Recent completion of pipe lines has introduced natural gas into Ontario and western Quebec. Thus, for the first time, electricity faces aggressive competition. Gas seems to have made enough inroads to call for defensive action.

Electric utilities have stepped up their sales promotion, particularly in Ontario where they have joined forces with manufacturers, distributors, and contractors to sell electric house heating. The Electric Heating Assocation of Ontario reports a growing acceptance of house heating and has broadened its aims to reach the commercial and industrial heating markets as well.



CHARLAND SUBSTATION'S CIRCUIT DIAGRAM depicts basic plan of Hydro-Quebec's ¼-million-kva substations in the Montreal area. Dorchester has equivalent equipment underground



Protect 12.5-Kv

Sectionalizing devices help Portland GE meet reliability needs despite the limitations on duty and on flexibility

FIG 1—ELECTRICAL LAYOUT shows typical open-bay substation using reclosers to protect two distribution feeders. Breakers could be substituted in layout

W. L. CAREY, Planning Engineer,
N. L. PAULSON, Distribution Engineer,
Portland General Electric Co, Portland, Ore.

Extensive use of sectionalizing devices including reclosers on 12.5-kv circuits has been adopted by Portland General Electric Co as the only available method of providing the desired reliability at reasonable cost. In this effort to keep up with the constantly increasing demand for better reliability, the company was concerned only with the balance between reliability and increased cost.

This balance is not arrived at by merely comparing reclosers with circuit breakers for substation feeder protection. Although reclosers may save $3,500 to $4,500 on each feeder position, there are two reasons for doubting that their performance will be satisfactory:

1. The duty imposed on a feeder interrupting device is closer to the rating of an oil circuit recloser than that of a circuit breaker.

2. There is less flexibility in setting, changing, and testing a recloser.

The addition of reclosers gave the company the advantage of reclosing, so that many non-persistent faults can be cleared without extended outage. This is important to the PGE system on which three-fourths of all faults are non-persistent.

Recloser protection can be superimposed on sectionalizing line-fuse protection in perfect coordination, so that only the faulted section and section fed by it are tripped by a fault. The reclosers' high speed makes it possible to interrupt faults before any line fuse is damaged. Reclosers properly applied achieve coordinated operation and fuse protection in what is called "protected coordination."

The records of one system division show an average recloser effectiveness of 60.5% for 1958, a figure based on 1,526 circuit-miles of 12.5-kv lines with 164 single-phase oil circuit reclosers mounted

Table I—Installed Cost Shows Savings for Reclosers

Device	Total Cost
Air circuit breaker A, 600 amp, 13.8 kv, 15,000 amp I.C., 2-cycle interrupting time	$127,740
Air circuit breaker B, 800 amp, 13.8 kv, 250 Mva, 2-cycle interrupting time	126,890
Oil circuit breaker C, 14.4 kv, 250 Mva, 5-cycle rating (3-cycle interrupting time)	126,000
Oil circuit recloser D, heavy duty, 14.4 kv, 8,000 amp I.C. (symmetrical)	118,860

	Interrupting Rating, Amps	Continuous Rating, Amps	Momentary (1-sec), Amps
Air breaker A	10,200	600	35,000
Air breaker B	14,400	800	53,000
Oil breaker C	9,930	600	40,000
Oil recloser D	8,460	560	(None)

Circuits Reliably, Economically

in 59 locations. Only three of 19 feeders had complete protected coordination for the entire year, and their recloser effectiveness averaged about 80%. The improvement was accomplished with about the same number of reclosers per 100 miles, but with extensive re-fusing to insure protection of all branch-line fuses.

To evaluate the performance of reclosers, the following expression was developed:

$$\% \text{ Recloser Effectiveness} = \frac{\text{Recloser-Cleared Faults} \times 100}{\text{Total Faults}}$$

Recloser-cleared faults are those cleared without damage by automatic operation of the recloser. The number is obtained by subtracting from the monthly recloser-operations' count all operations associated with recloser lockouts and blown protected fuses. Total faults are the sum of all time outages plus all recloser-cleared faults.

Recloser effectiveness can never exceed the ratio of non-persistent faults to the total faults. When recloser effectiveness equals this ratio, every non-persistent fault was cleared by recloser operation and every persistent fault by a recloser lockout or blown fuse. When recloser effectiveness is less than this ratio, some non-persistent faults were cleared by recloser lockouts or blown fuses.

Reclosers are set for one or two high-speed interruptions followed by three or two slower or retarded ones. The high-speed interruption attempts to clear the fault before a fuse is damaged, but when the fault persists, the retarded interruption delays long enough to force the intervening fuse to blow.

The fuse-recloser combination must be chosen for maximum available fault current, so that the fuse withstands maximum fault without damage until the recloser has had time to interrupt the fault. The larger the recloser rating, the higher the fusing level required. In general, each rating of recloser coordinates with and protects not more than three standard fuse link sizes. In the most favorable conditions, a given recloser "reaches out" through three fuses in series to interrupt a fault before any fuse blows.

A single set of large reclosers in the main feeder line near a substation can extend reclosing protection to 50 or 60 miles of main line and branches of rural feeders. Where more than three sets of fuses in series are needed to reach the ends of certain branch lines, additional smaller reclosers and line-sectionalizers may be substituted for the first set of fuses on any major branch beyond the initial recloser. Operating coil rating of 200 or 140 amp is reasonable for main-line application on 12.5-kv feeders out of 7,500-kva substations.

An alternate plan, one in wide use, is leaving the main lines clear and using separate reclosers for each important branch line. This takes more reclosers and does not give recloser protection to less important lines, yet usually permits a lower level of fusing.

Convinced that the interrupting speed of 8-cycle breakers was not desirable and prompted by development of heavy-duty reclosers, PGE investigated all available high-speed interrupting devices for use as substation breakers. Only four met the

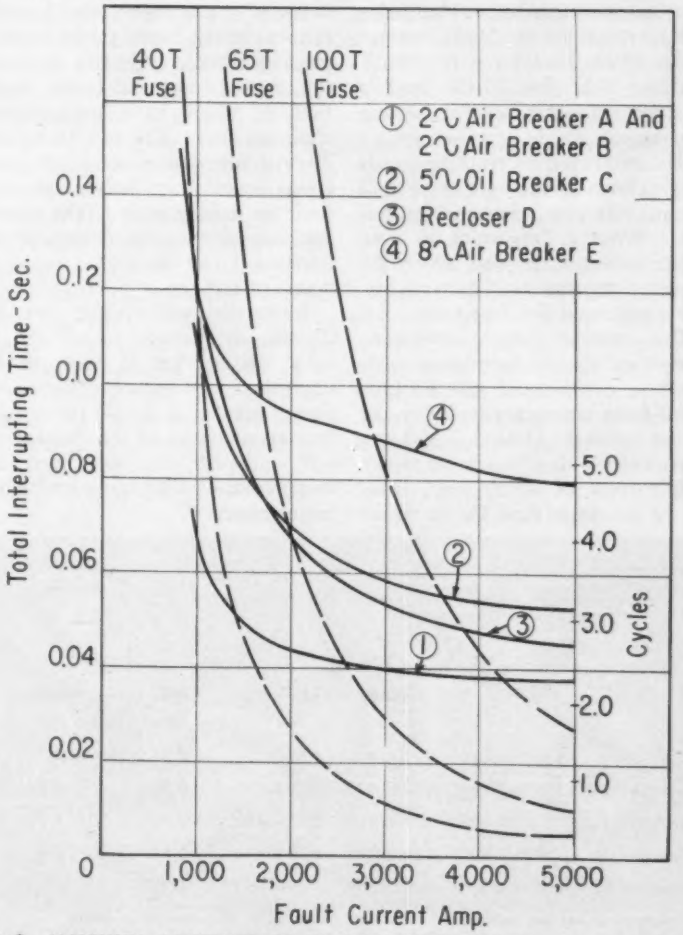


FIG 2—MAXIMUM INTERRUPTING TIME-CURRENT CURVES of approved devices are shown for 800-amp pickup. The 8-cycle breaker is for comparison

required interrupting time of 3 cycles or less at maximum rating. Since this investigation, PGE's interrupting-time requirements have been met by other manufacturers, although data on these devices were not available for inclusion in this comparison.

Comparative substation costs for these devices in open-bay construction, including equipment, structures, labor, substation development, and property outlays, are in Table I. As the interrupting ratings of the four devices are in different terms, they are converted to symmetrical amperes at 13 kv in the lower part of the table.

It is noteworthy that the continuous-current rating of the circuit breakers is limited by the temperature rise of the conductors and contacts only. The current rating of the recloser is limited also by the rating of the series trip coil which is always in the circuit and carries the total load current. The series coil is rated 100% load continuously, 125% load for 4 hr, 150% load for 2 hr, but 175% load is not recommended except during tripping.

The maximum interrupting speeds of the four devices are in Fig 2 for an 800-amp relay pickup setting. What is important to note is the current range over which the breaker interrupts fault currents before a protected-line fuse melts.

The current ranges determine how close to the substation each size fuse can be and still be protected from temporary faults by the station breaker. For a 7,500-kva transformer with a maximum feeder fault current of 4,600 amp, fuses can be no closer than the distances for a 336.6-MCM ACSR feeder given in Table II.

Not enough data are available to measure the effect of high-speed interruption on service continuity, although several generalizations can be made:

1. Service continuity is increased.

2. Service continuity is increased most on short urban feeders where the decrease in the unprotected zone is a considerable portion of the total feeder length.

3. Service continuity is increased to a lesser degree when transformers larger than 7,500 kva are used, unless some means is taken to limit the available fault current.

Has Disadvantages

The protective coordination of a recloser has the disadvantage of lacking flexibility, involving the expense of more test equipment, and requiring inconvenient setting changes. But the additional flexibility of a relay-controlled breaker is unnecessary, as the feeder breaker must coordinate only with high-side transformer fuses and feeder fuses, both of which have similar fixed characteristics. The expense of additional test equipment is of small consequence when the reclosers are used on a large scale. The inconvenience of changing settings can be minimized by increased use of standard settings.

In the matter of maintenance, the 2-cycle air breaker A and the 5-cycle oil breaker C seem to be equivalent to 8-cycle breakers. Air circuit breaker B should require far less maintenance of the breaker itself, although the associated air compressor would require additional maintenance.

When oil circuit reclosers D are used for feeder breakers, it is probable that a more rigid maintenance procedure would have to be initiated for these reasons: The interrupting duty is closer to the interrupting rating; and no relay operation records are available as a guide, as the counter counts total recloser, not only fault, operations.

Besides, a $3,600 high-current test set with suitable instrumentation is required to check the time-current characteristics of the recloser. This test set weighs about 800 lb, and the recloser itself, without stand or metering, but containing oil, weighs about the same. A suitable procedure must be worked out to bring the reclosers into the shop for testing or for taking the test set to the substations.

Operating the reclosers appears to offer no difficulty. As there are no separate relays on the recloser, such as there are on the breakers, they cannot be blocked for emergency operation. This may be a disadvantage. But only experience will tell whether the superior performance of a circuit breaker is necessary. At best, a recloser may do the job no better than a good circuit breaker, and it may do a poorer one.

Table II

	Fuse Rating, Amps			Min. Miles of Feeder		
	100T	65T	40T	100T	65T	40T
Breaker A	800-4,200	800-2,600	800-*	0.25	1.85	*
Breaker B	800-4,200	800-2,600	800-1,450	0.25	1.85	5.0
Breaker C	800-3,600	800-1,850	800-1,050	0.70	3.50	7.30
Recloser D	800-3,800	800-2,000	800-950	0.55	3.10	8.5
8-CycACBE	800-2,900	800-1,700	Doubtful	1.40	4.05	Infinite

*Information not yet published for currents below 25% of interrupting rating.

EEI Industrial Relations Talks Set for This Month

The Edison Electric Institute's Industrial Relations Committee has set Sept. 26 through Sept. 28 for its 13th annual round table conference for operating and industrial relations men. The meeting, to be held in the Drake Hotel in Chicago, will feature multiple conference discussions on "The Cost of Manpower," "The Growing Task of Management," "Using the Employee as an Envoy," and "Daily Teamwork."

Among the luncheon speakers will be Sherman Knapp, president of Connecticut Light & Power Co and of the EEI; J. K. Horton, president of Southern California Edison Co, and S. L. Drumm, president of West Penn Power Co.

A special feature this year will be a Tuesday evening panel on "The Manpower Challenge of the Nuclear Plant," with panel members from Shippingport and Dresden.

Grounding Is a Local Problem

Four major alternatives provide important advantages and disadvantages in industrial distribution system grounding practices; each alternative should be weighed in deciding which is best for a particular system

A. N. ELIASEN, Electrical Project Engineer, Sargent & Lundy, Engineers, Chicago, Ill.

The choice between grounded and ungrounded design for an industrial distribution system should be based on the individual conditions prevailing at each plant. Choice of the best system is determined by process requirements and operating conditions. But to make the proper choice, a thorough understanding of the advantages and disadvantages of each alternative is necessary. What are the possible alternatives?

1. The isolated delta system, the oldest 3-phase industrial distribution system in use, is championed by engineers who place first emphasis on avoiding production stoppages. Its chief advantage is that service and production are not interrupted even if one phase is grounded. Its main drawback, a tendency for multiple damage from one fault.

Many isolated delta systems are 480 v with 600-v insulation or 2.3 kv with 5-kv insulation. The "extra" insulation thus available helps the equipment withstand the increased voltage to ground during ground faults. Perhaps this "help" is one of the mainstays in the widespread use of isolated delta systems at these voltages.

2. The grounded neutral system, the prevalent one today when both transmission and distribution voltages are included, appeals to those who place top priority on rapid fault clearing. A fault on such a system does not multiply and is quickly cleared from the system.

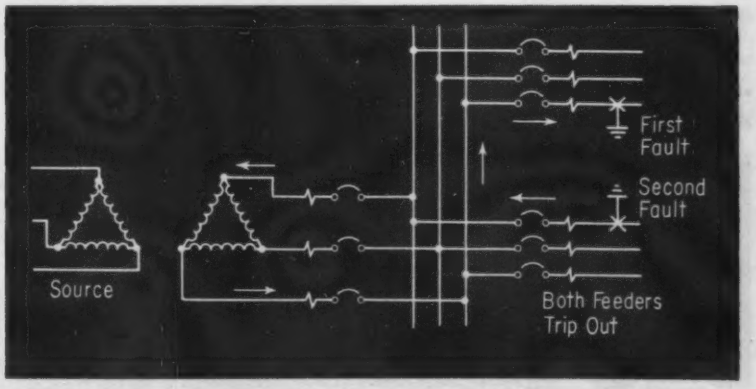
3. The grounded corner-of-the-delta system does not have a large number of advocates. However, it does provide an economical method of converting an isolated delta system to a grounded system. The permanently grounded phase remains at ground potential, while the other two phases are at full-line-to-line voltage above ground and to one another. Although the stress on the insulation of these two phases is always greater than it would be in a grounded-neutral system, the insulation is not subject to the additional transient over-voltages that might occur during a ground fault on an isloated delta system.

4. The ground fault neutralizer system is, strictly speaking, a special kind of grounded neutral with impedance in the neutral. It uses just enough reactance to balance the capacitance current in a ground fault. If the fault is temporary, the arc goes out and the system is restored to normal. If the fault is permanent, the ground-fault neutralizer is bypassed, solidly grounding the neutral. The fault must then be cleared by tripping the faulted feeder.

Although the voltages from two phases to ground increase to full line voltage during a ground fault, as in the isolated delta system, the ground fault neutralizer system virtually eliminates transient overvoltages. The ground fault neutralizer is rarely used on low voltage systems because it requires more equipment than either the isolated-delta or the grounded-neutral system and is, therefore, more expensive.

The difference in operating characteristics of these systems is most obvious when a single phase-to-ground fault occurs. Most low voltage faults are single phase-to-ground or start that way.

On an isolated delta system, the two ungrounded phases will go to



1 **TWO-PHASE FAULT,** more likely on an isolated delta system as it ages, interrupts service. So engineers are leaning to grounded systems

full line-to-line voltage. There will be a little unbalanced capacitance current flowing in the circuit and the ground detectors will show that there is a ground on the system. But, if the insulation on the two ungrounded phases is sound, the system will probably continue to operate and there will be no disruption of production.

However, as systems increase in size and voltage, the capacitance and the charging current increase. This, in turn, increases the possible damage from overvoltages caused by restrike of an arcing fault or restrike while switching to find the faulted circuit.

What happens to these faulted, isolated delta systems?

In some cases, the operator will switch the various circuits or use special ammeters to hunt down the ground. If the plant has a continuous process, this is usually done on overtime or on a weekend.

In other cases, a second breakdown will occur on another phase or circuit. Then the system has a full-fledged phase-to-phase fault, Fig 1. This fault does interrupt service. One or both of the circuits trip out and one or both of the trouble sources must be found and repaired or left off before service can be resumed.

As the system grows older and the insulation ages, the chance of multiple faults grows greater. Experience with this "double trouble" —two or more faults resulting from one arcing ground—are the reason more and more operators and engineers are leaning to a grounded system.

When a ground fault hits a grounded system, it is cleared quickly by protective devices which trip out the faulted feeder. Only the circuit in trouble is interrupted; the rest of the system continues to operate. If the faulted feeder is essential for a continuous process load, there is usually provision for a spare piece of equipment which can be started quickly and sometimes automatically.

If a high voltage conductor contacts the low voltage conductor of a grounded system, the overvoltage is limited—a distinct advantage over the isolated delta system. Moreover, with a grounded neutral system, modern 277/480-v fluorescent lighting can be used at a saving in total cost.

Can Convert Isolated Delta

An isolated delta 480-v system which has been giving trouble can be converted to a grounded-corner system. This will provide, at minimum cost, the benefits of fast fault clearing and limited over-voltages, at some sacrifice in service continuity. In making the conversion, all overload devices, all meter and instrument elements, and both overcurrent devices must be checked to make sure they are connected in the ungrounded phases throughout the system.

It is desirable, but not necessary, to add overcurrent protection to all circuits on the system. Loads which can tolerate only an extremely short interruption can be served from two sources, with a throw-over scheme. This, of course, increases the cost.

In some cases, conversion to a grounded neutral system may be preferable, specifically if:

1. It is desirable to use 277/480-v fluorescent lighting;

2. The isolated delta system is to operate at 575 v;

3. Maintenance is to be done "hot";

4. Equipment insulation is questionable.

Conversion to a grounded neutral system minimizes phase-to-neutral voltages during faults and thus minimizes insulation stress during faults. Unfortunately, replacing an existing delta-connected transformer, zigzag, or delta-wye, as shown in Fig 2, can be quite costly. Also, on older delta systems, additional short-circuit or overcurrent protection in the third phase of the breakers may be necessary. Fortunately, modern standard switchgear has three short circuit protective devices for each phase.

A grounded system should be grounded at the source or sources, and not at the load. On a grounded neutral system, the neutral need not be carried to 3-phase loads, but it must be carried to all single-phase loads which are connected phase-to-neutral.

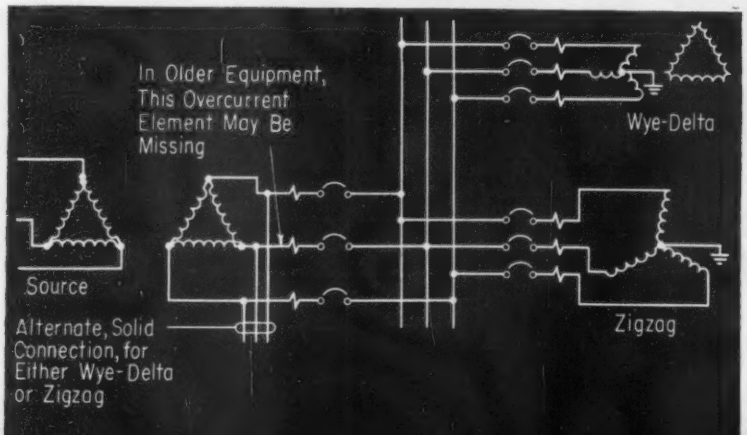
Occasionally, more impedance is added in the neutral of a grounded neutral system to reduce ground fault current. In a system of 600 v or less this has important disadvantages and should be avoided.

First, the use of neutral impedance increases the cost. Second, the ground current return paths must have low impedance to assure tripping direct, series-trip devices used in low-voltage systems to the current transformer and relays used in high-voltage system. Third, too high an impedance will permit overvoltages during faults. Because modern, high-speed, low voltage air breakers can clear a fault before much damage is done, it is rarely necesssary to add impedance to the neutral of a low-voltage system.

However, on 2.3-kv or 4-kv systems, the fault current does not decrease as quickly as it does on a 480-v system when the fault is farther from the source. And the combination of relays and circuit breakers does not clear as fast as the 600-v equipment. Therefore, the fault damage can be greater.

Typically, a neutral resistor sized to permit a 1,000 to 2,000-amp neutral current is used to reduce the ground current and thus the fault damage. If the ground relaying is carefully designed, higher resistance can be used successfully.

2 **CONVERSION OF AN OLDER DELTA SYSTEM** to grounded neutral may require added relays and breakers, so can be costly


In Older Equipment, This Overcurrent Element May Be Missing
Wye-Delta
Source
Alternate, Solid Connection, for Either Wye-Delta or Zigzag
Zigzag

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GENERAL ELECTRIC

Pressed Plate Footing Simplifies Erection

A footing recently developed by the Bonneville Power Administration for steel transmission towers saves about 45% in material weight over conventional grillage footings. Furthermore, it simplifies erection methods and access problems, while cutting labor costs.

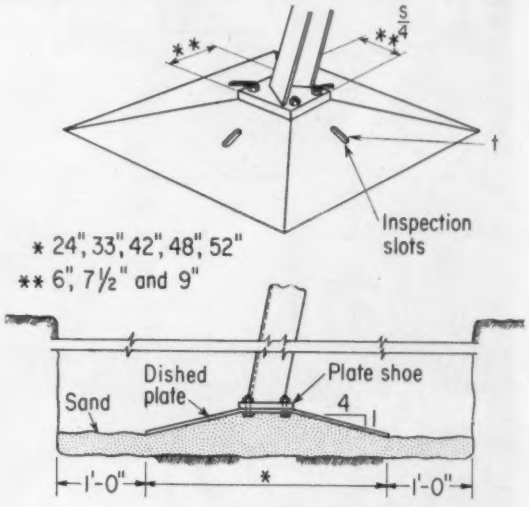
The galvanized steel-plate footing is dished into the form of a pyramidal frustum. The tower leg is bolted to its upper surface and its approximately concave side provides a large amount of soil bearing surface. When the plate footing must resist uplift forces or is used as a guy anchor, its convex side bears against the soil above it.

Tests were made on full-size footings, bearing on sand, to determine the stabilities and load capabilities of various sizes and thicknesses of plates. All footings tested had a side slope of 1 vertical to 4 horizontal. For this configuration the determined yield strengths of the various samples were consistent and could be expressed accurately by the equation:

$$P = KSt^{3/2}$$

in which P is the yield strength of the footing, in lb,
K is 13,500 lb for ASTM-A7 carbon,
S is the perimeter of the upper surface, in inches,
t is the plate thickness, in inches.

Tests show that the footings had fairly distinct yield points, but no tendency to collapse with loadings beyond the yield points. Individual plate footings are now being used to carry loadings up to 110,000 lb. A larger load requires an array of two or more plates.



New Lightweight Pruner Cuts Hazards

A new lightweight pruner, developed and assembled by a service crew of Washington Water Power Co, makes tree trimming along residential and urban distribution lines easier and less hazardous. Furthermore, the unit requires less maintenance and has greater mechanical strength.

Built around a standard lightweight plastic hotstick to which a cutter is attached, the pruner has far greater insulation value than a wooden pole pruner. After having used the new pruner for over a month, the crew reports, "the pruner is much lighter and easier to work with—of course, using the hotstick as the pruner handle makes it much safer around energized lines."

(More EUM on page 68)

HOW YOU CAN PUT TELEVISION TO WORK

A brief report on how to use KIN TEL closed circuit TV systems to cut costs, reduce errors, up efficiency

Today, hundreds of companies are solving a wide variety of business and industrial problems with KIN TEL closed circuit TV systems.

For example:

U. S. Steel uses a KIN TEL system to see inside open hearth furnaces.

The Los Angeles Department of Water and Power uses one for remote viewing of water-level meters.

Convair, Douglas, Lockheed, and Northrop all watch rocket tests with KIN TEL systems.

Westinghouse watches nuclear power reactor tests with one.

American Potash and Chemical monitors conveyor line and warehousing operations with one.

The San Francisco Naval Shipyard uses one to guard against pilferage.

These, and many other KIN TEL customers—both large and small—have discovered a significant fact: *Closed circuit television is no longer a novelty.* It's a proven, practical piece of equipment that, in many instances, pays for itself within a year. It's a modern, money-making piece of equipment that you can use in your business, in your plant, in your operation.

What Is a Kin Tel Closed Circuit TV System?

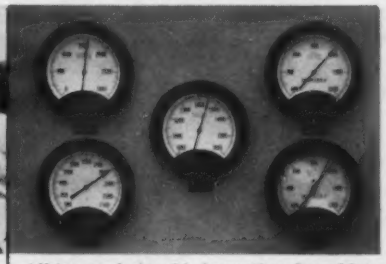
The basic system manufactured by KIN TEL consists of a rugged yet sensitive camera that is small enough to hold in your hand; a receiver that displays pictures that are twice as sharp as you can get on your home TV set; and a camera control unit that is so automatic the only control you have to touch is the on-off switch.

More Than Likely, Your Business Can Use Such a System.

You can use one to watch events or operations that are tedious, difficult, dangerous, or even impossible for men to watch.

Dependable KIN TEL TV systems see where men cannot survive; withstand tremendous extremes in temperature and pressure; perform both critical and routine jobs inexpensively, faultlessly, safely, tirelessly.

You can use one for data transmission.



All types of visual information–from blueprints to fingerprints to graphs–are transmitted over great distances quickly, accurately. Such systems save money, reduce errors and confusion, speed operations.

You can use one for surveillance work.

KIN TEL cameras scan vast areas; guard valuable equipment and property; never blink, quit, sleep, or make an error; watch many operations at once; transmit all information to a central monitoring point.

You can use one for on-the-job training.

Students study operations viewed by a KIN TEL camera. Such systems permit mass teaching that gives each student an unobstructed view; provide on-the-spot realism; end expensive, disturbing plant tours.

Here's What a Kin Tel System Can Do for Your Business

It can do what it is doing, right now, for hundreds of other firms. It can increase the over-all efficiency of your entire operation. It can help you tighten production and inventory controls, help you better your services to customers and clients. It can reduce errors and confusion and duplication. It can cut costs. It can save you time and money. It can free valuable men from tedious and routine tasks. It can give you the modern tools you need to keep pace in this highly competitive market.

For a more specific analysis of how KIN TEL TV can go to work for you, write direct for catalog 6-103 and the name of your nearest KIN TEL engineering representative.

8 Reasons Why So Many Firms Insist on Kin Tel TV Systems

1. Reliability. KIN TEL equipment is designed to keep working, day in and day out. It's the first choice for ICBM and other missile programs that depend on TV, that can't afford to compromise with reliability.

2. Picture Quality. Full 650-line resolution provides maximum delineation, essential for qualitative observation of complex operations, and for transmission of printed material.

3. Automatic Operation. KIN TEL TV is the only closed circuit system that provides entirely automatic, through-the-lens compensation for light-level changes of several thousand to one.

4. Sensitivity. With KIN TEL equipment, the light needed to read this page is enough for sharp, clear pictures; and usable pictures can be provided with less than one foot-candle illumination.

5. Ease of Installation. No site preparation is needed, no interacting electrical adjustments are required. All units fit in standard 19-inch racks.

6. Simplicity of Operation. With no changes in lens iris to make, the only thing the operator has to know is the location of the on-off switch.

7. Adaptability. A complete line of shelf-item system components and a variety of cameras and monitors permit observations of nearly every kind of operation, under all kinds of conditions.

8. Application Help. You don't have to waste your money and time on application engineering. At no obligation, KIN TEL's nationwide factory-trained field engineers will determine whether or not a TV system can be put to profitable use in your intended application.

KIN TEL
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KIN TEL—pioneer and leader in closed circuit television

'Vacuum' Cleans Boiler Areas Without Fuss

A vacuum cleaning device cleans the grating and cable trays in boiler areas of TVA's Gallatin Plant almost unnoticed, as other crafts continue their work nearby unhindered. The cleaner, operated by two men, eliminates the old method of starting at the top elevation and "blowing down" with its accompanying dust, dirt, trash, and confusion.

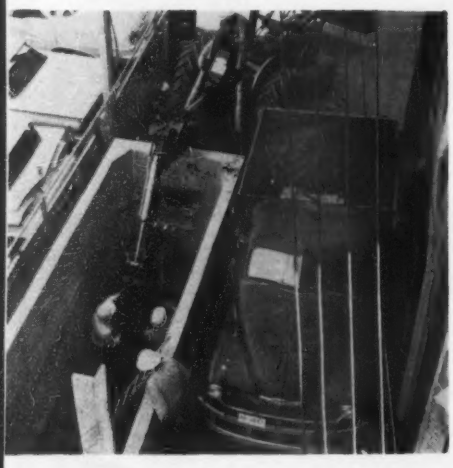
The cleaner, developed and fabricated at the project sheet metal plant to mount on a standard 55-gal drum, is built around a 3-in. Lamb air pusher. The body of the unit was made of 20-gauge galvanized sheet metal. All fittings and accessories were made from surplus and scrap materials.

Air flow is created in the pickup hose by the venturi action of the air pusher. Air from the 100-psi station service is introduced to the pusher, with flow directed toward the outer cylindrical chamber of the housing. This air flow causes a low-pressure zone on the suction side of the air pusher to achieve an induced air flow through the pickup hose and nozzle. The debris-laden air, traveling through the nozzle, hose, and air pusher, enters the outer chamber of the housing tangentially, thereby creating a cyclone effect. A sheet metal cylinder, the upper end of which is connected to dust bags, extends downward about 2 ft into the vortex of the whirling air and trash. Four slots, 5½ in. high and shielded on the windward side, allow the air to exhaust from the outer cylinder into and through the dust bags. The trash is deposited in the drum below.

Thirty feet of 2-in. rubber hose allows a considerable cleaning radius before it is required to move the unit. The pickup nozzle and hose may easily be moved about by one man, while two men can easily move the cleaner and drum receptacle together. When the drum is full, it can be easily removed and another drum substituted immediately.

For use as a portable cleaning device a vacuum bag, rather than a drum, may be connected directly to the airpusher, with the bag accumulating the trash.

Prefab Transformer Vaults Minimize Traffic Snarls



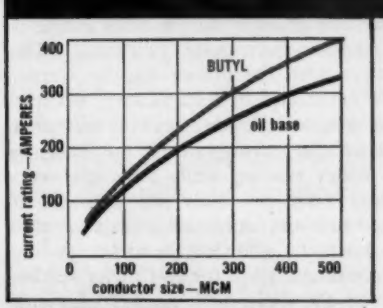
Prefabricated vaults sharply reduce transformer installation time and labor for Public Service Co of Colorado. Furthermore, in sharply decreasing the length of time during which vehicular traffic at the job-site is disrupted, the pre-built vaults promote excellent public relations.

Prior to installing the 42,000-lb stressed vault frame, the pavement, if any, at the vault site must be removed over a rectangular area slightly in excess of 20½x6¾ ft. Next the floorless concrete vault frame is lifted and placed within this cleared area so as to rest on the bare ground. A trenching machine then proceeds to remove the earth from within the vault walls. As the earth is removed, the concrete frame slowly descends, with walls serving as casements to prevent the sides of the hole from caving in. Finally, a concrete floor is poured and a prefab top is installed when the vault frame reaches the required depth.

The prefab vault pictured here was installed in the record time of five days. On-the-spot construction of the same vault would have required 14 working days, plus another week for the concrete to set.

ENJAY BUTYL

BEST WAY TO HANDLE ELECTRICITY



Butyl's outstanding resistance to heat allows considerably higher currents for any given conductor size.

Of all vulcanizable rubbers, Enjay Butyl offers the best electrical and dielectric properties. Butyl is the ideal material for wire and power cable, transformers, tapes, busbars and other insulation applications.

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Utility Reads Meters by Phone

Daily meter reading by phone is being tried out by Northern Illinois Gas Co on large industrial customers. No one at the factories has to answer the phone, and the system works on Saturdays and Sundays, too: it's all done by relaying and carrier equipment of types long familiar to utility people. There seems to be no obstacle to reading electric meters the same way.

E. L. Tornquist, research director for Northern Illinois Gas, put together the first equipment in his basement. His department has worked with Illinois Bell Telephone Co to develop operational models for trial with two customers. If these prove successful, Northern Illinois Gas will extend this method to read all 60 of its industrial meters that must be read daily.

Operation of the scheme is simple. The operator in the utility's office picks up his phone and dials the meter, which has its own telephone number. When the meter-end equipment sends back its carrier tone, the operator pushes a button on the receiver and the apparatus does the rest. A readout unit displays the meter reading. The operator has only to copy it down before going on to dial the next meter.

At the meter end are a transmitter and a Bell Telephone Data-Phone. The transmitter reads the meter and converts the information to an input for the Data-Phone. Heart of the transmitter is a set of notching relays. The Data-Phone changes its input to carrier current pulses and transmits them to the receiving end. Ordinary telephone service—no leased line is needed—handles the connection. The receiving end equipment is essentially the inverse of the transmitting set. A Data-Phone converts the line signal to an input for the receiver, which, through its set of notching relays, positions the readout device for the operator to read.

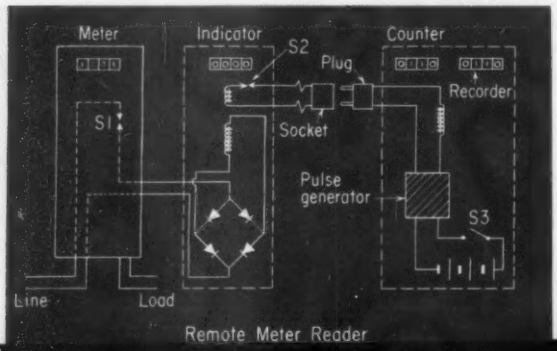
Although the system is costly in its present development stage, it shows promise of becoming economical for these 60 industrial meters. A practical similar system for reading residential meters would depend upon developing a cheap transmitting device for the customer's end. Illinois Bell Telephone believes all meters in a telephone area could be read during off-hours without disturbing customers.

CUSTOMER'S METER DIALED by apparatus developer E. L. Tornquist.

Devices Read Indoor Meters From Outside

LONDON (*McGraw-Hill World News*)—English metermen can now read indoor meters—in the majority in Great Britain—from outdoors. Two simple devices that Landis & Gyr, Ltd, of London have come up with do the job with the help of a pair of contacts (S1) added to the meter.

The contacts are closed by the "units" shaft of the meter, once per turn. Each "make" pulses the first of the two devices, an indicator installed alongside the meter. An auxiliary winding in the indicator is wired to a socket outside the building.



Remote Meter Reader

The meter reader plugs the second device, also an indicator—called a "counter" to distinguish it—into this socket. He sets his counter dials to zero and turns on (at S3) its transistorized pulse generator. This pulses both counters until the indoor one has turned forward (numbers increasing) to reset at zero, when its contacts (S2 in the schematic) open to cut off the operation. Because, when the pulsing starts, the indicator inside shows the meter reading while the meterman's counter starts from zero, his dials are arranged to rotate backwards (numbers decreasing) so that they end up, as in the schematic, showing the meter reading. This is the kwhr consumed since the last meter reading —shown directly on the dials, with no need for subtracting. The meterman's counter also marks these figures on a printed record.

Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Profitability? Faced with the decision to expand your plant facilities, you should first determine whether all elements combine to form a pattern of future profitability. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers designs and builds all types of power plants—steam-electric, gas turbine, combined cycle, nuclear and hydro-electric. From Pre-Engineering through design and construction, Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

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6229-P

MOLONEY DISTRIBUTION TRANSFORMERS ARE DESIGNED TO MEET ALL SYSTEM REQUIREMENTS

Comparative analysis of distribution transformers invariably leads to one conclusion . . . the best distribution transformer has all characteristics of design carefully developed in respect to their contribution to system efficiency, dependability and economy.

In Moloney Distribution Transformers, no one feature, electrical or mechanical, is radically improved at the expense of another. Instead, each part of the design is carefully considered and balanced with the others, to provide a distribution transformer that will give the best all-around system performance.

Utility systems benefit from this philosophy of design because every Moloney Distribution Transformer feature is designed to perform in the best possible manner compatible with every other aspect of the design, and thus provide "More Power To You."

Desirable Characteristics of Moloney Distribution Transformers Include . . .

Low Core Loss	Impulse Strength
Low Exciting Current	Low Impedance
High Overload Capacity	High Efficiency

Here Is How They Are Achieved.

SUPERIOR PERFORMANCE BECAUSE...

1 Design

Computers review hundreds of possible designs in a relatively short time, to obtain design parameters which promise to develop into the best all-around distribution transformer design. Design engineers review the computer data. Then guided by Moloney's extensive experience in transformer design and also by utility requirements, they prepare the final design.

2 Low Core Loss and Exciting Current

Skillful application of high grade cold rolled grain-oriented silicon steel, carefully handled and annealed, gives low core loss and exciting current. The core design uses one turn laminations with the ends butted one against the other. To minimize the required exciting current, the butt joints are staggered, providing a high permeability path for the flux.

3 High Overload Capability

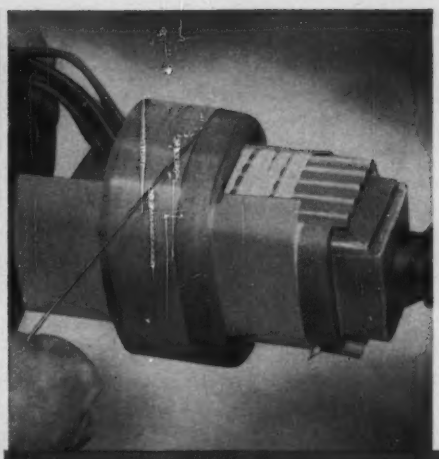
Corrugated pressboard, strategically placed, forms cooling ducts which expose a larger area of the winding surface to the oil, thereby reducing the winding gradient. The result is a lower hottest spot temperature under all conditions of load. Therefore, under conditions of overload, any loss of transformer insulation life is minimized.

ME60-3

MOLONEY ELECTRIC CO.

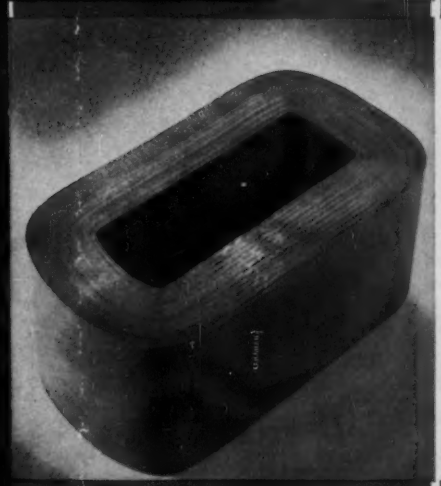
Since 1896 . . . ***MORE POWER TO YOU***

SALES OFFICES IN ALL



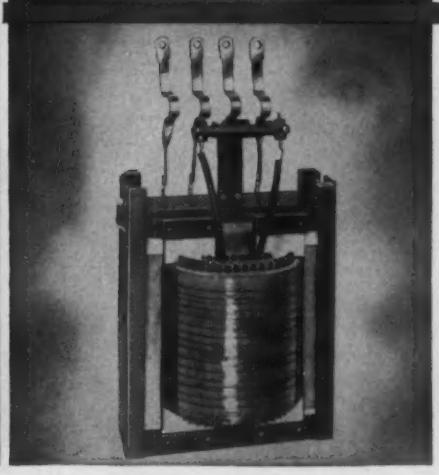
4 High Impulse Strength

At the line ends of the high voltage coil, extra insulation is provided between layers of the winding, and cording is placed between adjacent turns. At higher voltage ratings the high voltage winding is sectionalized to reduce the voltage between adjacent ends of succeeding layers. This practice reduces the turn-to-turn and layer-to-layer stresses and, consequently, gives the coil high impulse strength.



5 Low Impedance, Improved Voltage Regulation

The low-high-low sequence coil design used in Moloney Distribution Transformers is one of the contributing factors to low impedance. Because of this low impedance, Moloney Distribution Transformers have a lower internal voltage drop under all conditions of load. The result is improved voltage regulation which means customer satisfaction and increased revenue.



6 High Efficiency

The efficiency of any transmission and distribution system depends wholly upon its components. The high efficiency of Moloney Distribution Transformers, resulting from low total losses, is one of the reasons why Moloney Transformers, installed in your system, afford . . . "More Power To You."

Procurement & Products

BIDDING ▶ **Identical bids again raise complaint from Tennessee Valley Authority.** In letters sent recently to seven domestic insulator manufacturers TVA Chairman Herbert D. Vogel reported that six of them had submitted identical bids of $3.25 per unit and one had submitted a bid of $3.20 a unit on a lot of 18,000 ten-inch, 15,000 lb suspension insulators. On the same contract, a Japanese firm had submitted a bid of $2.55 per unit. Under the circumstances, Vogel said the TVA Board had decided to reject all bids and readvertise. "We have done so because we believe it is within the power of American Industry to meet foreign competition in any field if it will but make a sincere effort to become truly competitive within itself."

Manufacturers have argued in the past, and will probably reply to Vogel, that such pricing is based on market-generated levels—that no manufacturer can be expected to get a higher price than the lowest quoted by leading suppliers and no manufacturer can afford to take a lower price. As for the low Japanese bid, some industry sources say that the same firm has bid much lower prices in the Latin American market and express wonder at the disparity between quotes below the border and bids in the US.

PRICES ▶ **Power transformer manufacturers had varied reactions** to General Electric Co's withdrawal of published prices on large transformers and substitution of "estimating prices" reflecting current and future selling prices (EW, Sept. 5, p 50). One expressed hope that the GE move would be a stabilizing factor on transformer prices. This competitor described the marketing situation as "chaotic" and transformer price levels as "unrealistic." But other competitors queried felt the level of GE's estimating prices generally reflected the going market level. There was general assent that GE's estimation of the situation for the next few years was reasonable in view of the excess capacity and previous overestimates made of the market. One commented. "We're not too pleased with present prices but we can live with them."

Geographical price differential is instituted by A. B. Chance Co on all 10-in. suspension and transmission pin-type insulators. The differential, averaging 3½% higher, is to apply to Chance's eleven-state western zone. At the same time, the company is making other price moves, all effective Sept. 12. These include: (1) Increasing prices 5% on distribution insulators including low-voltage pin, guy strain, and suspension less than 10 in. in diameter; (2) Increasing prices approximately 6% on 10-in., 25,000-lb transmission insulators; and (3) making price adjustments by unit, on multipart, transmission pin-type insulators.

Other manufacturers commented that the Chance announcement might be a step in the right direction but that it was so complicated it would require considerable study. One thought there may be some merit in the zone differential, but said its true value could only be determined by extensive consideration.

EQUIPMENT ▶ **Proposal for a 800-Mw steam turbine generator is being discussed** between manufacturers and Tennessee Valley Authority. TVA recently announced preliminary plans to use a unit of this size in the northeastern part of its system. TVA says the conversations with manufacturers are for the purpose of developing specifications. It is anticipated that construction will start in mid 1962 for operation in 1964.

TVA has also announced that it will put a second 500-Mw generating unit at its Widows Creek plant in northern Alabama. Brown-Boveri will supply the turbine-generator and Combustion Engineering the boiler. The first 500-Mw unit, built by GE, will go into operation there next month.

introducing

PENNSYLVANIA'S NEW POLE STAR® *tri-unit* REGULATOR

1
PROVIDES INDEPENDENT PHASE VOLTAGE CONTROL

2
REDUCES INITIAL COST ⅓

3
SAVES ⅓ PAD SPACE

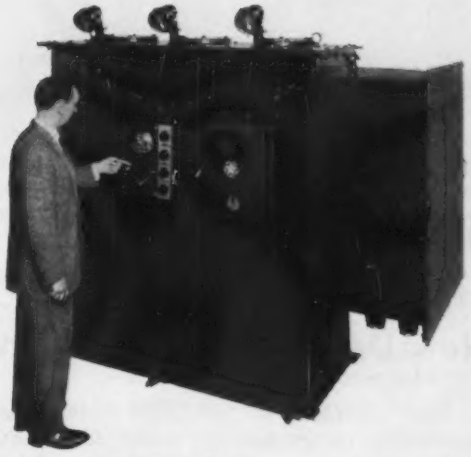
Pennsylvania's new low-cost Pole Star Tri-Unit Regulator combines the operating advantages of single-phase regulation and the installation economies of 3-phase equipment.

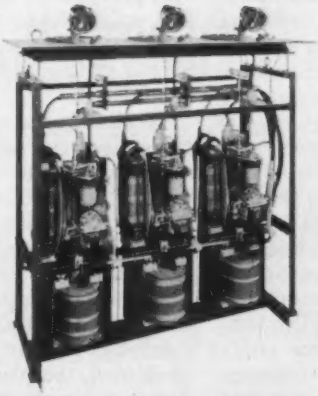
Three standardized, fully-automatic Pole Star single-phase regulators with time-proven direct-drive mechanisms, assembled in a single tank, reduce costs below conventional 3-phase station-type regulators. Savings of ⅓ and more are passed along to you. In addition, you save ⅓ in pad space required for these rugged, service-proved regulators.

You receive substantial benefits from the superior quality of independent single-phase regulation, compared to conventional gang control. The closer overall 3-phase voltage control and the higher average voltage, extend feeder capacity and increase revenue from voltage-sensitive loads. These advantages continue throughout the life of the equipment.

No other regulator offers so much for your investment and operating dollar.

For further information on the Pole Star Tri-Unit Regulator, write on your company letterhead to Distribution Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pa. For descriptive data on Pennsylvania's complete line of regulating equipment, request a copy of Bulletin 81.



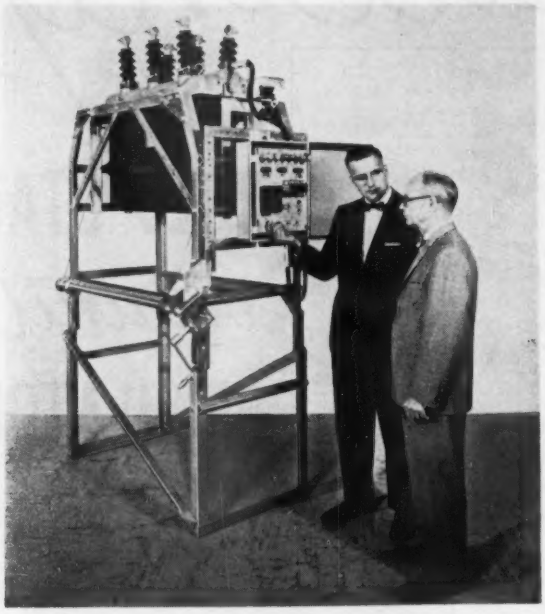


Developed in answer to needs expressed by utility people, the Pole Star Tri-Unit Regulator can readily be equipped with a terminal chamber for cable connection, as illustrated by 225-kva, 4330-volt unit. Cover bushings for open-wire connection can be furnished. Available in voltage classes 15 kv and below, automatic regulation range is plus and minus 10% in 32 steps of ⅝%. Standard regulator sizes are combined into these triple-unit assemblies.

View of internal assembly shows main windings below, and regulating mechanism alongside the switching reactor for each phase. The entire assembly is handled with lifting eyes in the bolted-on cover.

PENNSYLVANIA DISTRIBUTION TRANSFORMERS AND REGULATORS

Oil Reclosers Electronically Controlled



CONTROL PANEL for new type of oil circuit reclosers just introduced is explained by Blaine Schultz, mgr switchgear engineering, to N. K. Delaney, both of Line Material

Electronically controlled oil circuit reclosers were introduced in the market this week by Line Material Industries. Two types, designated RE and WE, make up the new line which is said to provide increased flexibility and ease of installation, testing, and adjusting in addition to the advantages offered by previous reclosers.

Type RE is rated 400 amp continuous and can interrupt up to 4,000 amp at 14.4 kv. Type WE is rated at 560 amp continuous and can interrupt up to 8,000 amp at 14.4 kv.

Both reclosers feature choice of two fast and four retarded time-current curves which can be employed in a sequence consisting of one, two, three, or four operations to lockout. Minimum-trip settings range from 100 to 1,120 amp and different reclosing intervals can easily be obtained. Ground-fault tripping can be provided for currents down to 50 amp.

The new reclosers can clear fault currents in 2½ cycles or less over most of their operating ranges to insure protection of conductors and equipment. Dual timing enables selective sectionalizing.

These devices require no secondary source of power. Operating characteristics can be adjusted or the control can be tested without interrupting normal service.

The use of solid-state timing devices makes it possible to check time-current curves in the field with completely portable equipment.

New Design Is Key to Aluminum Use

"The approach to aluminum transmission towers must be made through new concepts of structural design, such as the three-legged tower (photo at right)," explains Walter M. Franklin, director, electrical markets, Reynolds Metals Co.

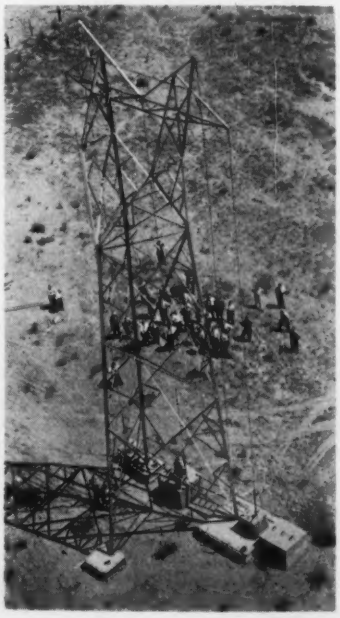
The new tower design is but one of a score of experiments that Reynolds is conducting near its new Phoenix, Ariz., plant. Here the firm is concentrating its efforts toward designing, testing, and fabricating primary structures for use by the electrical industry in transmission towers, substations, and switchyards.

Orders from half a dozen utility companies for aluminum structures are turning the Phoenix operation from an experimental station to an industrial complex. The firm's heavy fabrication plant in Phoenix has 13,000 square feet of manufacturing area plus storage space. It is only a few miles from the Phoenix extrusion plant where most of the aluminum structural material required is produced.

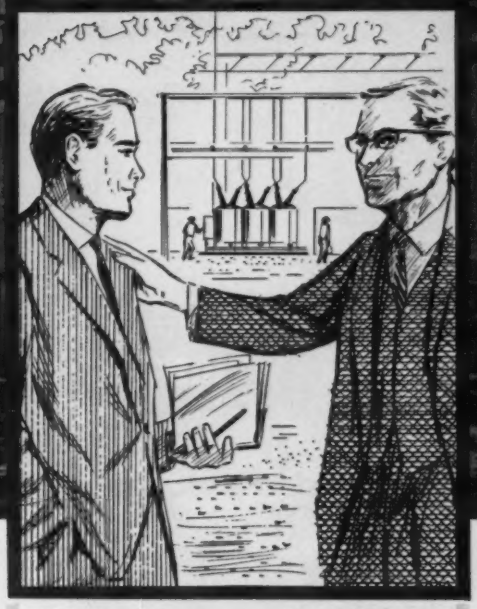
"With the marriage of the extrusion process and advanced design concepts, the use of aluminum in structural applications has proven to be economically sound," asserts Clarence Manning, vice president of Reynolds.

"Although successful experiments have proven that aluminum is suitable for all types of heavy structural fabrication, the plant at Phoenix is staffed to produce structures primarily for the electrical industry,"

(*Continued on page* 78)



One of four I-T-E, 230 KV power circuit breakers being installed at Southern California Edison Company's new 820-Mw steam station, Huntington Beach.



Doing business for more than 50 years—Southern California Edison Company and I-T-E's Kelman Division:

- **the first 30 KV oil breaker in 1906**
- **the first 230 KV oil breaker in 1937**
- **1000's of breakers between '06 and '60**

ANOTHER JOB WELL DONE...

by the Kelman Power Circuit Breaker Division of I-T-E

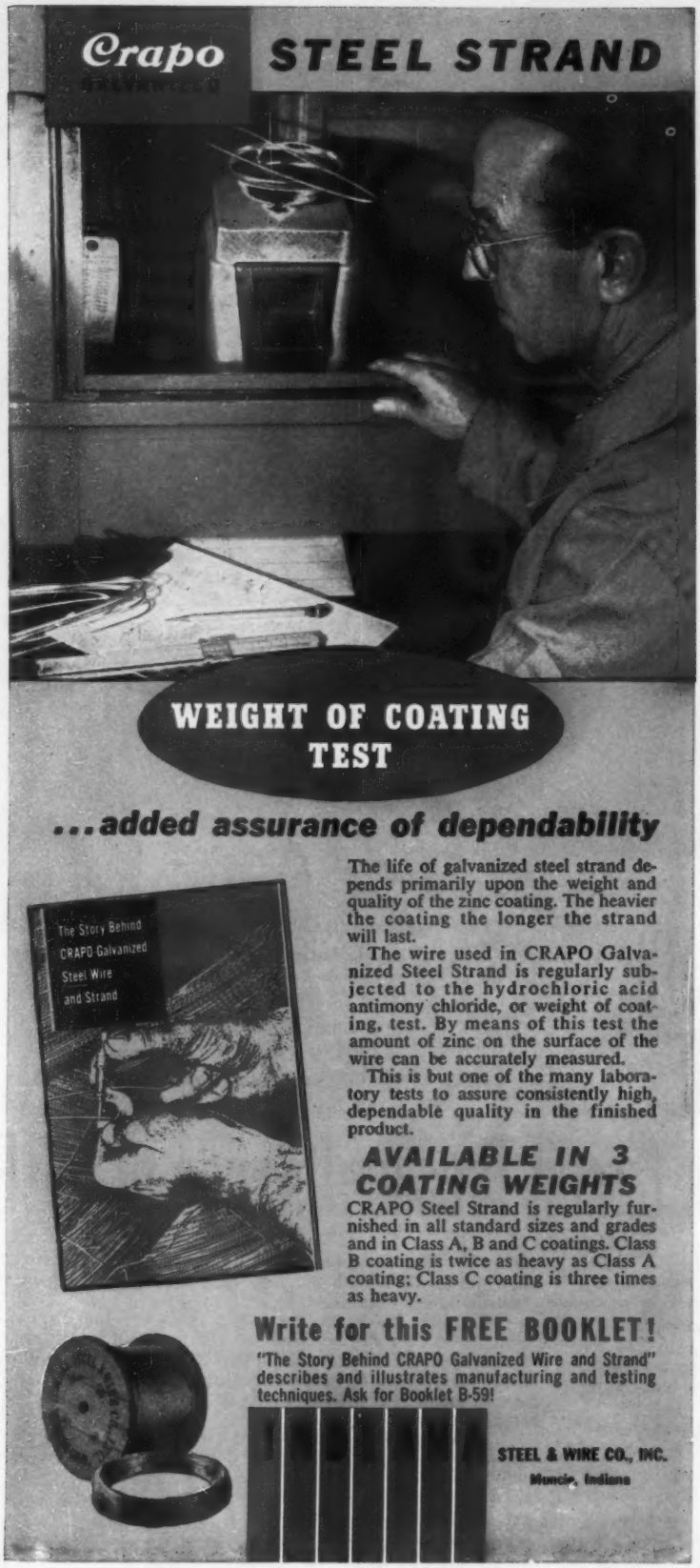
When the Southern California Edison Company of Los Angeles decided to boost the output of its new Huntington Beach steam station by adding two computer-supervised turbine-generator units, they selected each of their equipment suppliers with the utmost of care. The successful bidder for four, new, 230 KV power circuit breakers was the Kelman Power Circuit Breaker Division of I-T-E—people with whom this utility has been doing business for more than 50 years.

Back in 1906 the Kelman Electric & Manufacturing Company supplied the then Edison Electric Company with a 30 KV oil breaker. Since that time thousands of Kelman breakers have been put into service as the Southern California Edison Company has expanded its facilities to match the growth of the great California Southland.

Through the years, there has remained the same fine relationship that started fifty-four years ago. It is a business relationship that has been maintained by Southern California Edison Company's insistence on a quality product and I-T-E's determination to continue to supply that kind of product at a competitive price.

For descriptive literature on I-T-E's field-proven power circuit breakers, write to 1667 North Main Street, Los Angeles 12, Calif., Dept. EWO-962-2.

I-T-E CIRCUIT BREAKER COMPANY
KELMAN POWER CIRCUIT BREAKER DIVISION


Crapo
STEEL STRAND
WEIGHT OF COATING TEST
...added assurance of dependability
The life of galvanized steel strand depends primarily upon the weight and quality of the zinc coating. The heavier the coating the longer the strand will last.
The wire used in CRAPO Galvanized Steel Strand is regularly subjected to the hydrochloric acid antimony chloride, or weight of coating, test. By means of this test the amount of zinc on the surface of the wire can be accurately measured.
This is but one of the many laboratory tests to assure consistently high, dependable quality in the finished product.
The Story Behind CRAPO Galvanized Steel Wire and Strand
AVAILABLE IN 3 COATING WEIGHTS
CRAPO Steel Strand is regularly furnished in all standard sizes and grades and in Class A, B and C coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.
Write for this FREE BOOKLET!
"The Story Behind CRAPO Galvanized Wire and Strand" describes and illustrates manufacturing and testing techniques. Ask for Booklet B-59!
STEEL & WIRE CO., INC.
Muncie, Indiana

(*Continued from page 76*)

Manning said.

Franklin lists four advantages which he believes that aluminum has over other metals in fabricating transmission towers. These are:

(1) Requires less maintenance which would cause shutdown of service or the expense of painting "hot" towers.

(2) Weight advantage makes it easier to transport over difficult terrain.

(3) Has high corrosion resistance which makes it particularly adaptable in seacoast and industrial atmospheres.

(4) Has pleasing appearance.

Franklin believes that one of the big advantages of aluminum in various types of utility structures is that its light weight permits plant-assembly of large sections of a structure.

"The problem of marking and identifying thousands of small fabricated parts that must be assembled in the field, the problem of storage of these parts in the field, the problems of locating and securing proper parts for field erections, are items that do not have to be faced when aluminum is used," said Franklin.

Reynolds' heavy fabrication plant can subassemble and ship structures within the following size limitations: 12 ft high, 10 ft wide and 64 ft long. Under special conditions it can obtain extra long railway flat cars and ship structures up to 100 ft in length, but freight would be an expensive item for such structures.

MANUFACTURERS BRIEFS

I-T-E Circuit Breaker Co acquires Standard Electric Mfg Co, of Dallas, assembler of lighting and power switchboards.

Federal Pacific Electric Co breaks ground in Chicago for 175,000-sq ft building to hold regional sales offices, Economy Fuse's Illinois manufacturing operations, and the Economy Screw Co. Completion is planned for early 1961.

RT&E buys Milwaukee Sprayer Mfg Co, portable paint spraying equipment manufacturer. Purchase price was between $125,000 and $150,000.

NO MORE ENGINE IDLING

. . . with NEW MOTOROLA MOTRAC* 2-way radio

Idle a truck engine 4 hours a day—to regenerate for battery drain due to 2-way radio—and you waste *more than a hundred dollars* a year in gasoline alone! Add the cost of engine wear, replacement batteries, generators, etc., and you've got a significant cost leak.
But now it's *unnecessary*. Motorola MOTRAC radio uses only a trickle of current—less than a dome light—so engine idling is *out*. And that's just the *start* of MOTRAC radio savings. Truly advanced design and rugged construction give you greater *reliability*, and much longer life.
Here is truly dependable equipment for long-run economy.
It's a big story. Get all the facts about this outstanding new radio. Call or write today.

HERE'S THE INSIDE STORY—Commonest source of maintenance problems—vibrators and receiver tubes—have been replaced by dependable transistors. MOTRAC radio can be used with any 6 or 12 volt vehicle—positive or negative ground. Models available with up to 100 watts power output.

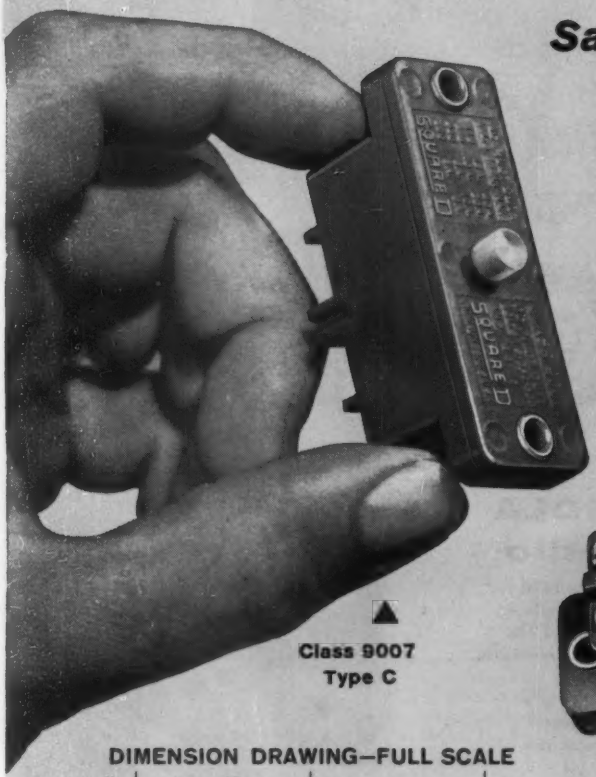
MOTOROLA 2-WAY RADIO

Motorola Communications & Electronics, Inc., 4501 A[illegible]usta Blvd., Chicago [illegible], A Subsidiary of Motorola Inc.

*MOTRAC is a trademark of Motorola Inc.

Now!..

SQUARE D PRECISION *SNAP* SWITCH AVAILABLE WITH 2 POLES!



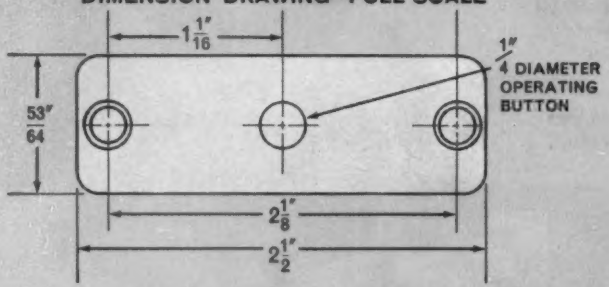
▲
Class 9007
Type C

Same size and mounting as single-pole switch

Here's a precision snap switch which combines 2-pole versatility with high electrical ratings—and takes no more space than a single-pole switch!

The new switch is available either single-throw (2 normally open or 2 normally closed) or double-throw, and like the single-pole switch, it features: double-break contacts—large screw-type terminals—strong melamine case—simplified mounting...a design which assures reliability, precise repeat accuracy and long mechanical life.

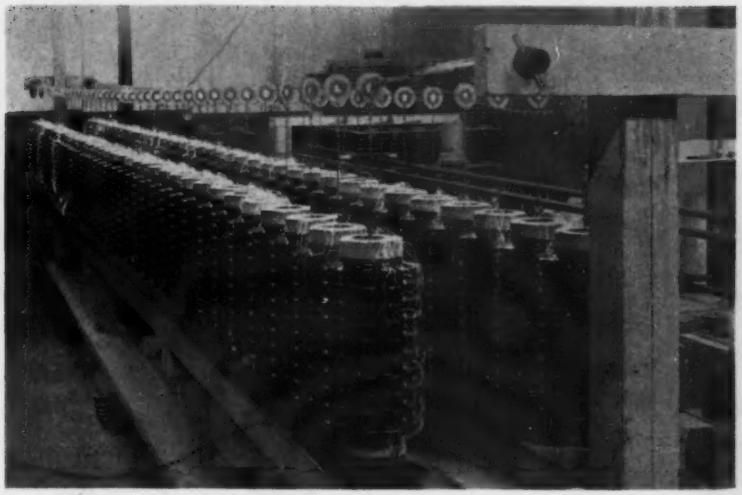
DIMENSION DRAWING—FULL SCALE



Write for details. Square D Company, Dept. SA
4041 North Richards Street, Milwaukee 12, Wisconsin

SQUARE D COMPANY

wherever electricity is distributed and controlled



New Process Stabilizes Insulator Loss

Lapp Insulator Co has applied for a patent on a new process which experimentation indicates will result in increased uniformity of the power factor, charging current, and watts loss characteristics of line and station post insulators.

The process consists of applying a thin coating of silicone to the walls of the insulator holes prior to plugging. This improvement has been incorporated in production for nearly three years. It is considered that this development offers a new level of uniformity and also protection against any hazard of defective plugging of the Lapp line and station post insulators.

One of the characteristics of line and station post insulators has been that they showed a considerable variation in power factor, charging current, and watts loss under Doble testing procedures. These variations caused no trouble, but were a matter of curiosity and, at times, concern in trying to explain exactly why they occurred, says Lapp.

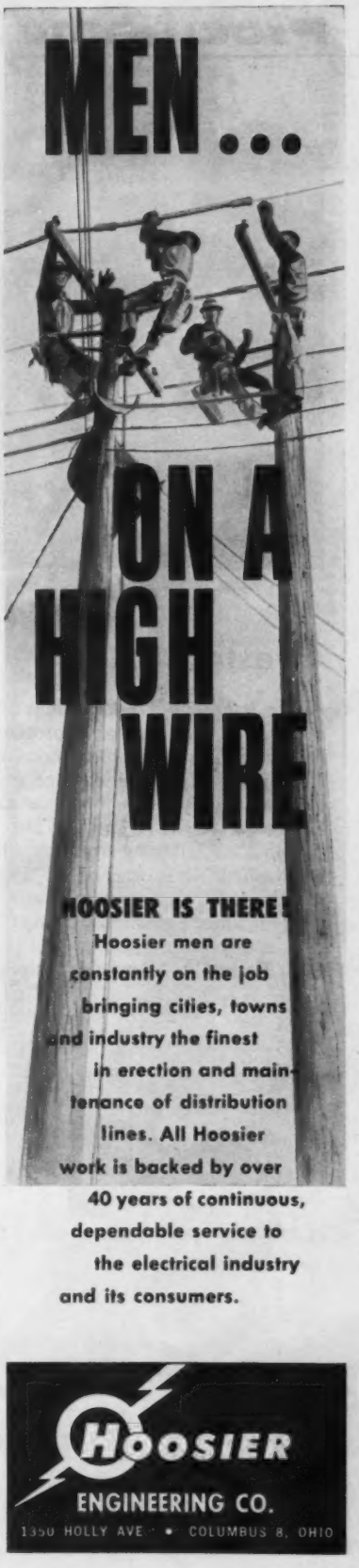
Some years ago the LeRoy, N. Y., firm discovered that the principal cause of these variations was the severe electrical test to which each insulator is subjected prior to assembly. In these tests (see photo above) each porcelain is inverted on a grounded steel plate and a chain is dropped to the bottom of the hole. A vigorous flashover is applied for three minutes or longer. This tests the soundness of the head and walls of porcelain.

During this test the hole in the insulator is filled with corona and contaminating particles are deposited on the inside walls of the hole. The amount of this deposit varies with atmospheric conditions prevailing at the time of the test. The effect varies with the amount of humidity in the air remaining in the hole at the time of plugging.

After arriving at the solution of applying a coating of silicone to the walls of the hole, Lapp sought to establish limits of effectiveness of the process. Test insulators were deliberately produced with defective plugs, mounted in horizontal and vertical positions, with and without silicone treatment. These have been on energized test for nearly three years outdoors.

Untreated test insulators proved noisy and show erratic loss, reports Lapp. Silicone-treated test insulators show unchanging low loss.

In view of the chemically stable nature of silicones, and because there is no attack of any kind on the coating, either physical or electrical, there is expectation that this coating will be permanent.


MEN...
ON A HIGH WIRE
HOOSIER IS THERE!
Hoosier men are constantly on the job bringing cities, towns and industry the finest in erection and maintenance of distribution lines. All Hoosier work is backed by over 40 years of continuous, dependable service to the electrical industry and its consumers.
HOOSIER
ENGINEERING CO.
1350 HOLLY AVE. • COLUMBUS 8, OHIO

Fused Interrupter Switch . . .

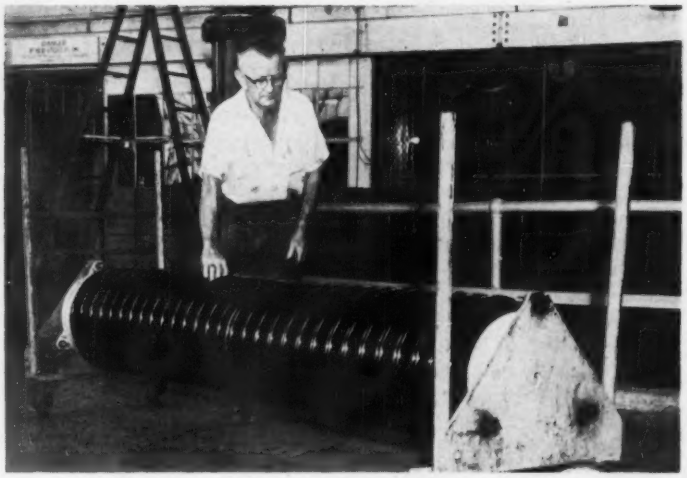
. . . for low-voltage (600-v) switchgear has a rated interrupting capacity of 100,000 symmetrical amp. The electrically operated drawout device, called Loadmaster 100, utilizes Buss Low-Peak dual-element high interrupting capacity fuses with sufficient time-lag to protect against needless circuit interruptions caused by harmless overloads. A motor-driven, spring-loaded, trip-free closing mechanism insures fast positive closing. It may safely be closed into its full fault-interrupting capacity. The Loadmaster 100 is available in 800 and 1,600-amp continuous current ratings, 3-pole, 600-v.

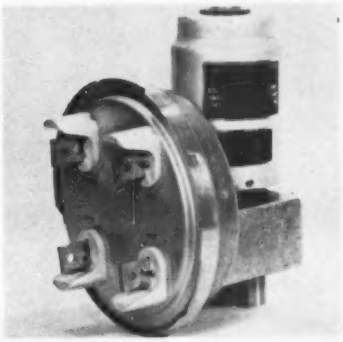
Pennsylvania Transformer Div, McGraw-Edison Co, Box 330, Canonsburg, Pa.

Arresters . . .

. . . in 3 through 276-kv ratings are enclosed in one-piece porcelain housings. The single-piece housing is to prevent internal damage due to contamination caused by external leakage currents. These Thorex station-class lightning arresters can be washed while energized. Previously, the larger arrester housings were made of sections cemented with epoxy resin.

Ohio Brass Co, Mansfield, Ohio.





Adapter . . .

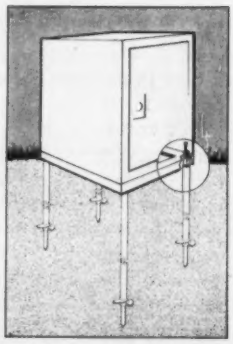
. . . enables a photoelectric control for individual lamps to control a group circuit. This permits replacement of a group photoelectric control. Two adapters are available, WTA 120 and WTA 120R. The latter has a 30-amp relay for heavy loads.

Tabet Mfg Co, 1336 Ballentine Blvd, Norfolk 12, Va.

Anchors . . .

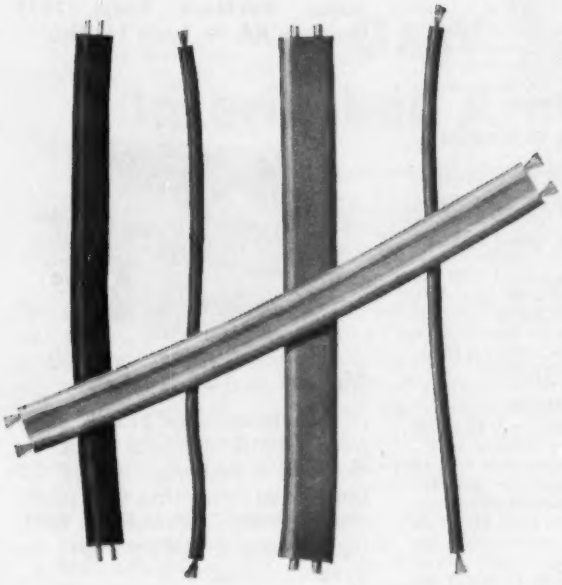
. . . support a distribution transformer and make a concrete pad unnecessary. Four anchors can be installed by two men. Each anchor's upper end is threaded for bolting to mounting brackets.

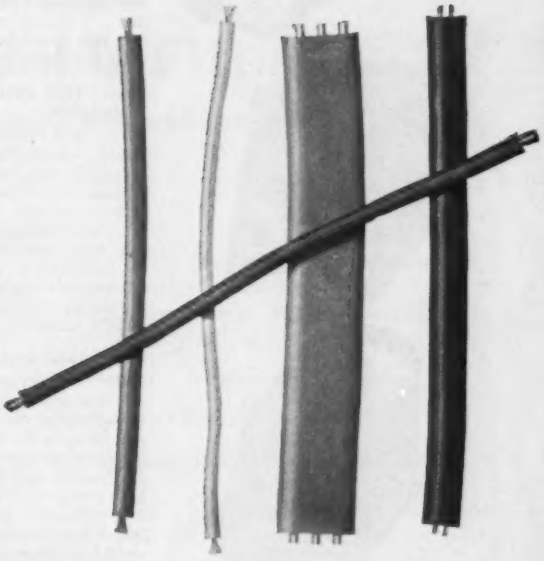
A. B. Chance Co, Centralia, Mo.



(*More New Equipment on Page* 84)

One for...





OPALON® 1038 vinyl compound meets 15 insulating and jacketing specifications*

Monsanto Opalon 1038 fills so many applications, it can streamline your inventory. It combines excellent extrudability, high insulating qualities, great heat resistance and toughness even after long use under rigorous conditions. If you need to meet any of the specifications listed below, write for 1038 data to Monsanto Chemical Company, Plastics Division, Room 752, Springfield 2, Mass.

Monsanto

MONSANTO DEVELOPER IN **PLASTICS**

***INSULATION**

U.L. T, TW, and 60° C. oil exposure on both copper and aluminum conductors.

U.L. underground feeder and non-metallic sheathed cable (UF-NMC).

Class 11, U.L. standard for flexible cord and fixture wire insulation and jacket.

IPCEA Appendix I.

ASTM D-734.

MIL-W-76A, Types LW, MW, and HW.

U.L. 80° C. appliance wire.

***JACKET**

ASTM D-1047 (Passes -40° C. cold bend).

UF-NMC.

REA Spec. PE-14.

IPCEA, Appendix J.

IMSA, Spec. 19 and 20.

Inside-outside telephone cable (Staple Gun Wire).

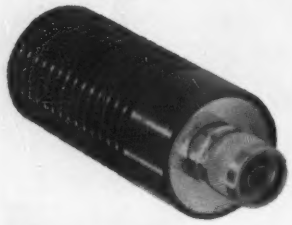
Jan-C-17A Type I.

MIL-C-15479A (Harbor Defense).

Look at the many different

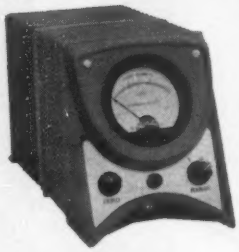
POWER MEASURING INSTRUMENTS

Sierra offers you now



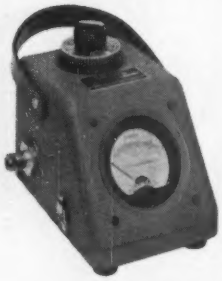
Model 160 50 ohm Coaxial Loads

Now including Models operating to 11 KMC, Sierra 160 Series low VSWR terminations may be used when stable 50 ohm loads are required. Featuring rugged design, high stability at full rated power, the loads have a typical VSWR of 1.2. All models are air-cooled and complete shielding insures personnel safety. Models with power capacities of 1, 5, and 20 watts are available with N, C and BNC connectors. 100 and 500 watt models Type N connectors. $20.00 to $170.00



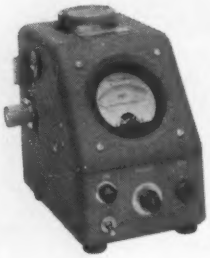
Model 185A Average-Reading Termination Wattmeters

Sierra 185A series are particularly useful in terminating rf coaxial transmission systems, measuring average powers between 20 and 1,000 MC, and as dummy loads for testing and adjusting CW and FM transmitters and oscillators. Three models with maximum power dissipation of 15, 100 and 500 watts, and power ranges of 0 to 5/15, 0 to 30/100 and 0 to 150/500 watts, respectively. Accuracy is ± 5% and VSWR is 1.2. Female Type N connectors. Model 185A-15FN, $170.00; 185A-100FN, $260.00; 185A-500FN, $315.00.



Model 164A Average Power Monitor

Sierra 164A Series Bi-Directional Power Monitors are now available with plug-ins down to 2 MC. Four plug-ins provide full scale ranges of 1, 5, 10 and 50 watts through frequencies 25 to 1000 MC. Two medium-power units provide full scale ranges 10, 50, 100 and 500 watts, 25 to 1000 MC. Two high-power units provide full scale ranges of 50, 100, 500, 1000 watts, 2 through 75 MC. Model 164 is now available with Type N, C, HN, UHF and LC connectors. Model 164, $115.00; plug-ins, $70.00 to $170.00.



Model 194A-A Bi-Directional Peak Power Monitor

Covering 200 to 1,215 MC, Sierra 194A-A Peak Power Monitor offers two important, time-saving features—peak power is read directly without computation and a reversible directional coupler permits incident or reflected power readings simply by turning one knob. Peak powers to 30 Kw are covered in 4 ranges. Measurement accuracy is ± 10% full scale at pulse widths down to 0.1 μsec or repetition rates as low as 10 pps. Minimum duty cycle 0.04% for specified accuracy. $460.00.

Data subject to change without notice.
Prices f. o. b. factory.

For complete details, see your Sierra Representative or write direct.

6562

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A Division of Philco Corporation
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Sales representatives in all principal areas.
Canada: Atlas Instrument Corp., Ltd., Montreal, Ottawa, Toronto, Vancouver.
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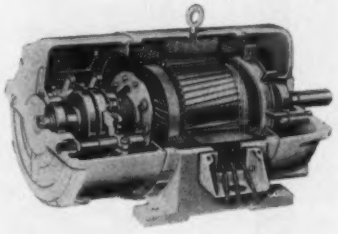
Screw Anchors . . .

. . . of steel for power installing are furnished in four sizes for all but very rocky and hard-pan soils. Average installation time is less than 10 min. A guy-wire eyenut comes on the upper end.
Jasper Blackburn Corp, 1525 Woodson Rd, St. Louis 14, Mo.



Motors . . .

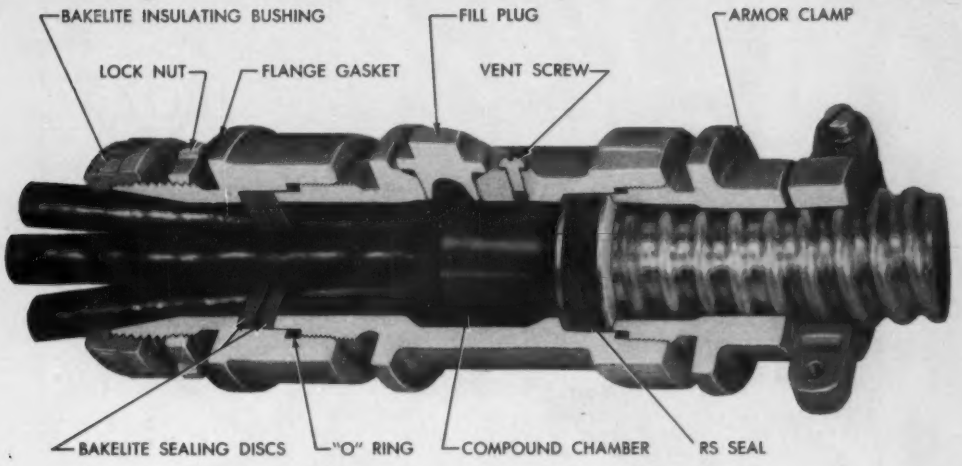
. . . in frame sizes 213 to 326U meet NEMA standards. The redesigned wound-rotor motors are smaller and lighter than their predecessors. They have cast iron housings, oversize grease reservoirs and dynamic balance.
Louis Allis Co, 427 Stewart St, Milwaukee 1, Wis.

More New Products

High-voltage dc test set, which produces 5 milliamp continuously at 50 kv, is for dielectric testing and leakage-current measurements. The model S50-5DC operates from 115 v ac.—Peschel Electronics, Inc, Patterson, N. Y.

Short and lightweight **brake motors** for equipment like cranes and hoists have cast iron frames and end shields. Ratings vary from ½ to 5 hp at 900 to 1,800 rpm.—General Electric Co, Schenectady 5, N. Y.

New from the only manufacturer of *all* cable accessories . . .



G&W Series 800 Interlocked Armor Cable Fittings

. . . accommodate all commercially available interlocked armor cable
. . . reduce installation time and effort
. . . available for immediate delivery

New G&W Series 800 Fittings not only terminate, but support, ground, mount, and dead end on the widest variety of applications. They offer simplified, modern design in only four basic pipe sizes to accommodate all interlocked armor cable now being manufactured. Eight different fittings in each size means faster installation from simple armor clamps to compound-filled terminations used in any position.

CHECK THESE SIGNIFICANT FEATURES:

- **High strength aluminum parts**
- **Resistoyl® gaskets**
- **RS seals proven on potheads, boxes, and switches**
- **Interchangeable components**
- **Water-tight construction**

G&W's Series 800 Fittings are an important addition to the only complete line of cable accessories available . . . G&W also offers the *best* engineering information service to assist you in any of the following areas:

Potheads . . . Terminating Kits . . .

Splice Kits and Boxes . . . Joints . . .

All high and low voltage Cable Accessories

Further proof that you save time and money by relying on the dependability of G&W's constant product development. For the detailed story on the new Series 800 Fittings, mail the coupon below for your copy of Catalog H.

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☐ Send me a copy of Catalog H detailing facts about the new G&W Series 800 Interlocked Armor Cable Fittings.

I specify interlocked armor cable for the following applications:

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Name and Title: _____

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superior quality standards
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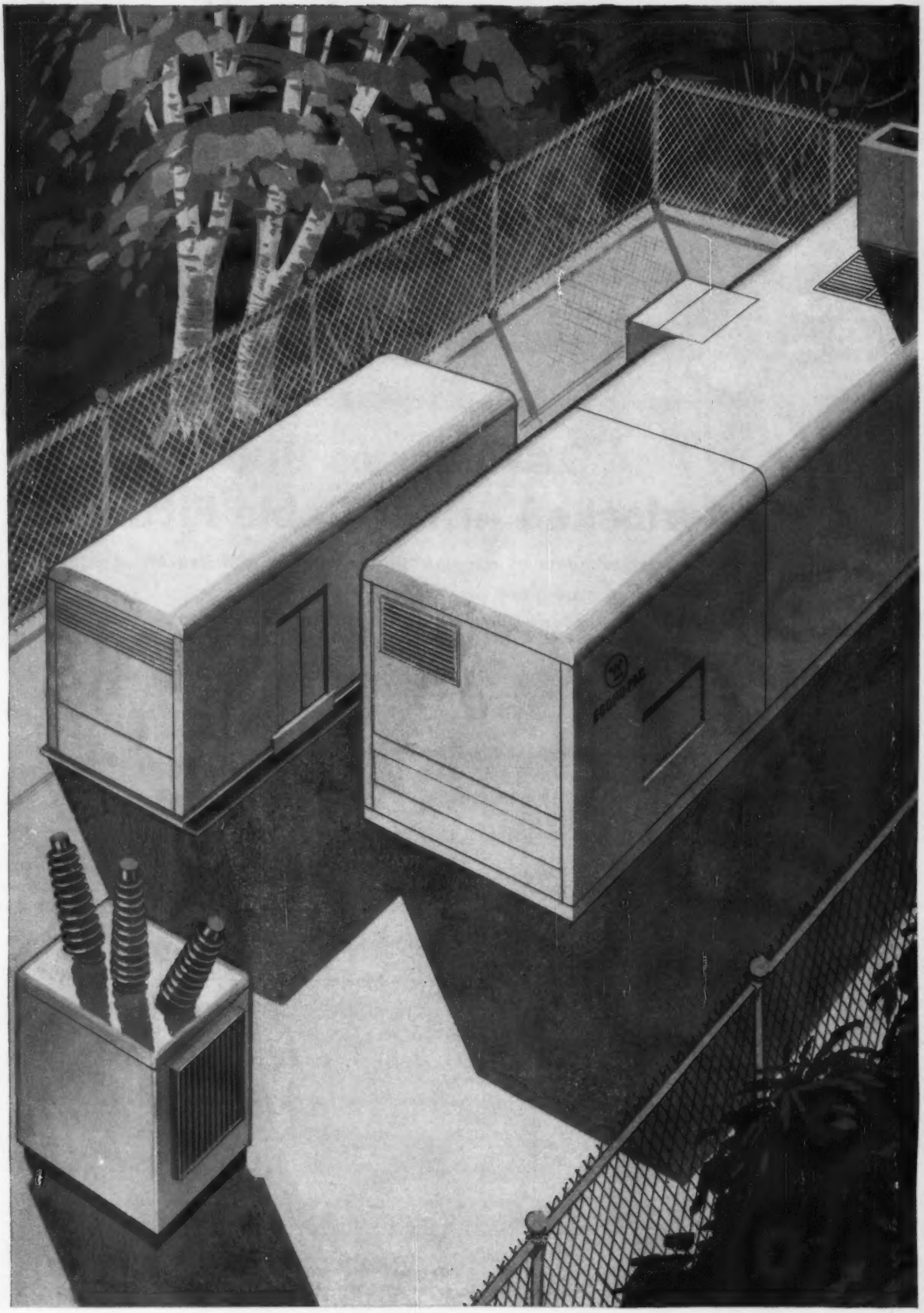


New Westinghouse ECONO-PAC Gas Turbine

3000, 7000 or 12,000 kw a self-contained plant for peaking, reserve and emergency cuts installed costs to $80 and $100/kw

Here is another new measure of economy in power generation—the Westinghouse ECONO-PAC* gas turbine power plant. The ECONO-PAC is completely integrated when delivered, ready for immediate use.

The complete installed cost of ECONO-PAC is as low as $80/kw, based on winter operation, or $100/kw for summer operation. These costs are decidedly lower than those for conventional plants of the same or even larger sizes. And, the ECONO-PAC features portability—goes as a unit to location where needed as loads change.

The Westinghouse ECONO-PAC gives these definite advantages:

Meets wide range of generating problems . . . peaking, reserve capacity or emergency service.

Fast installation . . . only fuel, electrical connections and a flat concrete slab foundation (about three feet thick) are needed to put ECONO-PAC into operation; means two weeks or less from arrival on site to start-up.

Fully automatic . . . unattended operation.

Portable component construction . . . complete unit can be relocated quickly to meet changing system loads.

Full capacity, dual fuel operation . . . uses the most economical fuel without loss of rated output.

Dry plant operation . . . radiator coolers eliminate cooling water requirements.

Increased capability at low ambient temperature . . . at 40°F, plant output is increased by 25%.

Quiet . . . acceptable in residential areas.

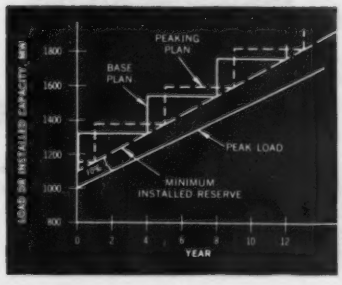
Call your Westinghouse representative for details on ECONO-PAC—the distinctive, low-cost power package. You can be sure . . . if it's Westinghouse.

*Trade-Mark

J-50618

Westinghouse

WESTINGHOUSE POWERCASTING STUDY REVEALS ECONOMY OF GAS TURBINE APPLICATION



Westinghouse conducted a Powercasting study recently for a utility working on a 4-year cycle of adding generating equipment. The study showed that addition of gas turbine plants permitted postponement of buying base-load generators for a year. This would make possible a potential net capital saving of over $800,000 over a 13-year period.

COMPLETE RANGE

Westinghouse offers a complete line of gas turbine power plants—ranging from 3 to 150 mw—engineered for your particular requirements.

When the heat's on...

ROEBLING TELLURIUM LEAD ALLOY SHEATH IS STEADY AND STABLE!

Wiping operations raise sheath temperatures up to 400° F. Stable sheath is what you need when the heat's on! And Roebling's Tellurium Lead Alloy Sheath retains its remarkable creep resistance and bending fatigue resistance under intense heat, and after it.

What's more, there's extra life built into the carefully made paper power cable *inside*. That's why there's simply no better cable buy when it comes to long life, dependable service, minimum maintenance.

Interesting test and other data are now available. Write today for your free copy of the booklet that shows the way to reduced cable and maintenance costs. Electrical Wire, John A. Roebling's Sons Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division, The Colorado Fuel and Iron Corporation

Roebling electrical wires and cables are available with either copper or aluminum conductors.

Price cutting is under very active discussion at the moment. There are two viewpoints. The purchasing agent is charged with taking unfair advantage of the manufacturer in this buyer's market and doing injury to the industry by beating down price levels and demoralizing values. The manufacturer is criticized for voluntary and precipitate price cutting impelled by eagerness for orders . . . . there is evidence enough to make the picture a distressing one . . .

SECOND IN A SERIES OF THREE ARTICLES

What Brought the Trouble?

The comments above, appearing some 32 years ago in Electrical World, could in most respects describe the equipment market as it is today with its soft prices. Of course, today there is the new factor of the antitrust actions. How did the market arrive in these straits, and what are the features that could have brought these problems about? These are the questions to be answered in this second of three articles on prices and the antitrust actions.

The marketplace in which the electrical utility buyers meet the electrical equipment sellers is but a variant of the general US modified-free-enterprise one. But there are significant characteristics that may help in understanding its pecularities.

The number of buyers is sharply circumscribed and subject to little change. Although they are monopolies in the service of electrical energy, they are in competition in two ways. First, they must compete on the open money market for about two-thirds of their expansion capital. Second, they must compete with other organizations who are also in the business of supplying energy to the consumer, usually in the form of fuels that are lower-priced than electricity. Thus electrical utilities are very price-conscious.

Another strong hallmark of electrical utilities is that their service must be continuously available, as gross business and social dislocations can occur in its unexpected absence. Thus the utilities are very quality conscious.

In addition, the utility buyers have a continually growing purchasing power, tied to the growing demand by consumers for their electricity. This has been well documented in the past by EEI and NEMA, and the future growth for the equipment market seems well-assured. In fact, the utilities *must have* the equipment to meet their expansion needs.

But one most interesting characteristic of these electrical utility buyers must not be overlooked—their *total demand at any given time* for a given product is what the economists call "relatively inelastic." That is, demand doesn't change much with price (unless there are alternate ways of performing the same service).

True, continually lower prices of a large number of product lines in time will show up in utility plant accounts and at least help retard rate increases which could increase consumers' demand for electricity and eventually the utilities'

demand for expansion equipment. But this is a long-term chain of events; for the short term, total demand for a product is sticky.

Such inelastic total demand means that competitive price changes may alter the way the market divides among competitors, but will not change the total market itself (except in the rare instance of 'white sale' when prices are so low that utilities order far ahead of need and planning). Discounting 'white sales,' if everyone's prices move the same in a competitive situation, the division of the market will not change appreciably, even though the level of prices has.

These are a few of the things that make the electrical utilities different kinds of buyers than those usually met in the American market place. What about the sellers, the electrical manufacturers?

Actually, they aren't too different from the average US industrials. As in numerous other fields, this market has one or more 'giants' in almost every product line. The giants, as well as some of the smaller competitors, are highly diversified, which makes it virtually impossible by inspection of profit-and-loss statements to tell how a company is doing in sales and profits on a given product, or for that matter, on its entire utility line.

Government statistics indicate that US "electric machinery, equipment, and supplies" manufacturers' net profits after taxes has declined fairly steadily from around 6.3% of sales in 1947 to under 4% in 1958, an annually compounded decrease of about 4%. During this same period, sales grew at an annual rate of 12%. But these statistics again mask the utility market.

In this marketplace, there has existed almost from the beginning (with a few exceptions) a rapport, a mutual trust between manufacturer and utility that is something nearly unique in American business. Each has been oriented strongly toward engineering and production, and much less so to marketing.

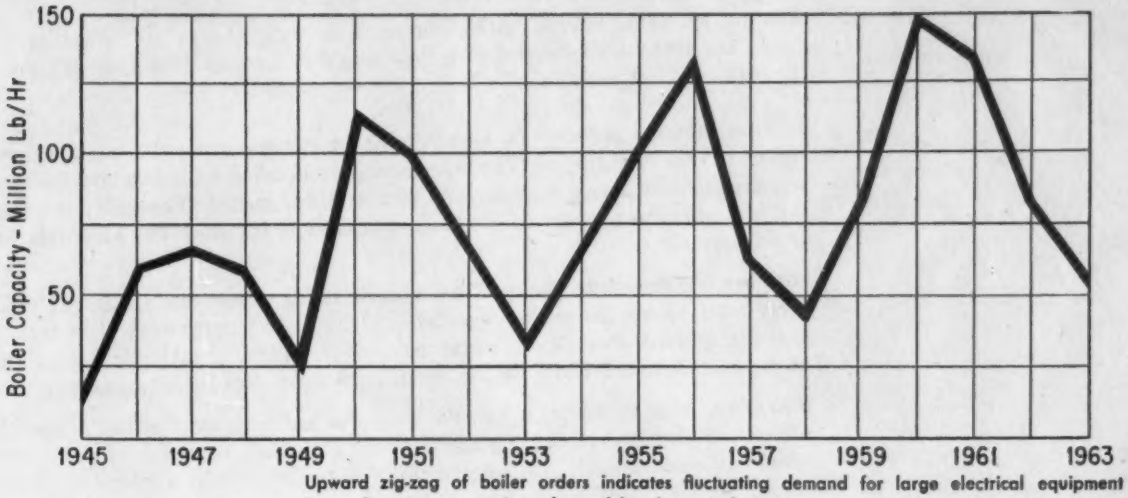
Thus a heritage of close communion at the product development level has been long established. By tacit agreement between buyer and seller, the manufacturer has done the vital and costly job of product research and development needed by the combined industry to hold the long-term line on expenses. Of course the products were priced to include R&D costs.

The manufacturers have high fixed costs, in plant, tooling, R&D and other items. This makes their costs per unit produced quite sensitive to volume, and hence to demand. And as utility demand for some products has had an increasingly strong tendency to fluctuate on an approximate five-year period (see chart p 91), costs under usual accounting procedures oscillate right along with demand, making pricing on a cost-plus-profit basis extremely difficult and unrealistic.

But regardless of how prices have been set historically, the buyer in general has had a degree of confidence in them. This confidence undoubtedly was based on the traditional rapport and mutual trust between manufacturer and utility, and on the fact that the huge industry was successful and growing.

During World War II, the utilities weathered the load demand while on a new-equipment ration. In this period, as during the Korean affair, there was pent-up consumer demand. As a result of these conditions, in the post-war years there was heavy requirement on utilities and manufacturers to get new capacity on the line. (Generating capacity increased 26% in the four years ending in 1949.) At the same time, inflation took an ugly swipe at expenses of both members of the team, and R&D costs skyrocketed under stimuli both to reduce manufacturing costs and to innovate products for the bright new world.

Manufacturers found both fixed and variable costs rising rapidly after price and wage controls were removed, and they passed these costs on to their buyers with abrupt rapidity. As an example, turbine-generator prices, which hadn't budged much since 1938, jumped about 60% between 1946 and 1949, and then con-



Upward zig-zag of boiler orders indicates fluctuating demand for large electrical equipment items. But at any one time, demand has been *inelastic*.

tinued upward at a not much slower rate. Boilers reacted even more sharply; other items to lesser degrees.

The psychological impact was substantial, although utility income, because it is much more dependent on other factors, did not react measurably to the price increases. Many of these increases were not handled with compassion, and many were not received with understanding. The long-time rapport and confidence that the price level was fair and equitable were shaken. Yet the demand for product, true to its inelasticity to price, held up.

A straw in the wind had previously occurred when, over a period, buyers had begun to question how published prices of some equipment failed to vary perceptibly among various sellers' catalogs. But most laid this to product standardization, recognized as a means of holding prices down. As long as *quoted* prices weren't identical, there was little protest. In general, published prices continued to be regarded with confidence as a measure of the market level, and movements in the prices as the signal for movement of the market level.

Now came an interesting development—the decentralization of product departments in some companies away from direct control by top management. The new product managers were given twin charges by corporate management—to innovate and expand to maintain or increase their share of the growing market; and to deliver an annual profit based on corporation budget requirements.

With rising costs, especially the fixed costs for R&D and new plant, the product managers were pinched between the two policies. With an eye on the projections for the future, they were motivated to expand capacity, and they did. With other competitors doing the same thing and new ones entering the market, industry-wide overcapacity in many lines became evident and individual shares of the market began to slip. Manager after manager found himself unable to meet his budgeted profits.

To increase, or sometimes just maintain, their plant loading, managers began to cut prices. When competitors followed suit for the same reasons, the situation naturally worsened. Plant load factors stayed relatively constant, but with lower prices, bogies were farther away than ever. Prices kept spiraling downward and the price war had begun.

Utilities, still smarting from the recent rapid price boosts, gleefully played the game to the hilt. On their side of the counter, top management had passed along the word to watch prices, and purchasing agents did just that.

The war got worse; buyers, casting caution to the winds, began buying against the future and ahead of engineering planning. And the sellers let them do it. This was the 'white sale' of 1954-55.

In time, calmness prevailed on both sides of the counter, and order was somehow restored to the marketplace. The manufacturers had taken a beating, and indulged in recriminations among themselves as to who had started it. Few concluded that the real villain was indiscriminate expansion of capacity which has kept right on to this day.

And few questioned the policy of top manufacturing management in setting rigid profit requirements for product lines while at the same time goading plant expansion ever onward. Few also called the action of the utilities in taking full advantage of the manufacturers' bad judgment by its right name: lack of statesmanship.

Too often, prior to the price war, the men who had been meeting in the market place—salesmen and purchasing agents—were given only the words of price with which to communicate. Missing entirely were the words representing other values: quality, reliability, delivery, service, etc.

When the armistice came, there was a determination by the manufacturers that the price war should not happen again. But over capacity grew and the cost squeeze continued. Little had been learned, except a hatred of price war, and that the competitive workings of the market place might not be sufficient for them to solve their problems.

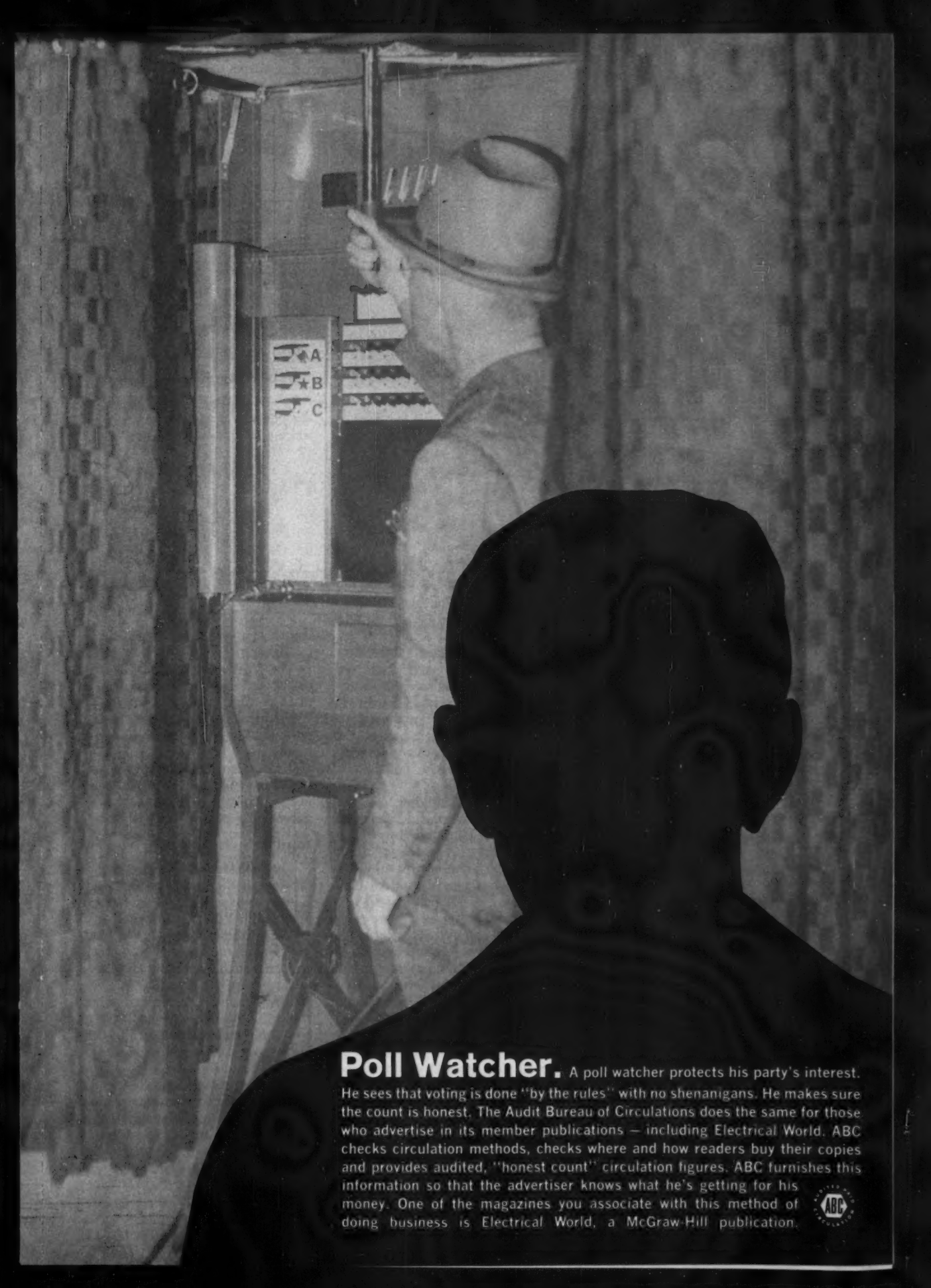
Prices regained their stability but many buyers had lost their previous confidence in them. So they began invoking various facets of coutervailing power against the seemingly great seller power. TVA stepped up its overseas purchases with the announced intention of getting prices into line and reducing manufacturers' profits. Other governmental buyers followed suit.

And some of the larger, tougher-minded investor-owned utilities began invoking their own kind of power—their buying power. They instituted rigid price surveillance policies and refused to purchase unless price levels took a position somewhere between what they regarded as the current, artificially-high levels and the distress levels of the 'white sale.'

Finally, one more facet of countervailing power was invoked—the government. Spurred by the growing number of complaints from public buyers about identical and supposedly collusive bidding, and spurred by Sen Estes Kefauver's (D-Tenn.) coming investigation of pricing practices of the electrical manufacturing industry, the US Justice Department empaneled grand juries in Philadelphia. The many antitrust indictments were the result. Prices turned soft again.

This time, all semblance of confidence in published prices was wiped clean. Although during the previous year buyers generally proclaimed that prices were unrealistically high, this time many agreed that prices had turned too low for the overall, long-term health of the manufacturers. The buyers feared reduction in quality, elimination of built-in margins, and the reduction in innovation efforts. Perhaps they were more statesmanlike than during the 'white sale,' but they seemed, as did the manufacturers themselves, powerless to bring order back to the market place.

In the final article next week, an attempt will be made to delineate what will be needed from both buyers and sellers if this electrical equipment market is to be healthy for all concerned.



Poll Watcher. A poll watcher protects his party's interest. He sees that voting is done "by the rules" with no shenanigans. He makes sure the count is honest. The Audit Bureau of Circulations does the same for those who advertise in its member publications — including Electrical World. ABC checks circulation methods, checks where and how readers buy their copies and provides audited, "honest count" circulation figures. ABC furnishes this information so that the advertiser knows what he's getting for his money. One of the magazines you associate with this method of doing business is Electrical World, a McGraw-Hill publication.

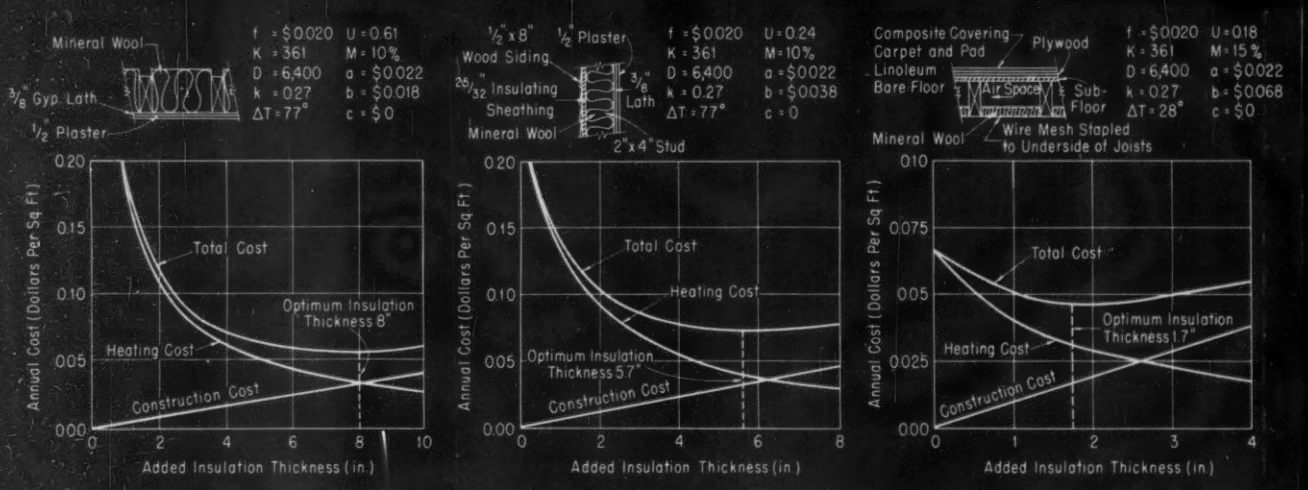

Mineral Wool
3/8" Gyp. Lath
1/2" Plaster
f = $0.020 U = 0.61
K = 361 M = 10%
D = 6,400 a = $0.022
k = 0.27 b = $0.018
ΔT = 77° c = $0
1/2" x 8" 1/2" Plaster
Wood Siding
25/32" Insulating Sheathing
Mineral Wool
3/8" Lath
2" x 4" Stud
f = $0.020 U = 0.24
K = 361 M = 10%
D = 6,400 a = $0.022
k = 0.27 b = $0.038
ΔT = 77° c = 0
Composite Covering
Carpet and Pad
Linoleum
Bare Floor
Plywood
Air Space
Sub-Floor
Mineral Wool
Wire Mesh Stapled to Underside of Joists
f = $0.020 U = 018
K = 361 M = 15%
D = 6,400 a = $0.022
k = 027 b = $0.068
ΔT = 28° c = $0
Annual Cost (Dollars Per Sq Ft)
Total Cost
Optimum Insulation Thickness 8"
Heating Cost
Construction Cost
Added Insulation Thickness (in.)
Optimum Insulation Thickness 5.7"
Optimum Insulation Thickness 1.7"

FIG 1—RESIDENTIAL CEILINGS annual cost reaches a minimum with 8-in. insulation thickness

FIG 2—RESIDENTIAL WALLS' annual cost is minimum with 5.7 in. of insulation thickness

FIG 3—RESIDENTIAL BASEMENT ceiling optimum insulation is 1.7 in., at which point annual cost is minimum

Selling

Optimum Insulation For Electric

C. E. THOMAS, Commonwealth Associates, Inc, Jackson, Mich.

Electric heating is here to stay because of its inherent advantages. Design materials and construction will have to keep pace.

Economic studies to determine how much insulation is desirable where electric heating is installed have shown that the latest accepted standard, in general, is not enough. Usually more insulation is economically justified. However, a national standard probably is not justified since the economics depend on so many variables, particularly climate, electric heating rates and the quality and cost of insulation. The type of structures and the cost of money to cover the investment costs also have a bearing on the amount of insulation that is economically justified.

A study of basic criteria, with examples, will give a better understanding of insulation thicknesses that are economically justified and the trend of influence in the factors involved. The thicknesses determined are "optimum thicknesses." The analysis is applicable to any kind of building—residential, commercial, industrial, school, or any other type in any geographical location.

Figures 1 through 6 demonstrate the variation of annual cost with thickness of added insulation. Each example is for a specific set of conditions. The examples consider one sq ft only of a surface, not the total surface area of the building. The study deals with building materials rather than complete buildings. The analysis considers only winter space heating, not cooling. Intermittent heating often used in churches is a special matter. Electric heating is assumed to be 100% of the resistance type. Heat pump heating or combination heat pump and resistance heating would, in general, reduce the optimum insulation thickness determined because of the lesser cost of delivered heat.

Each example is based upon specific conditions. Values of the variables used in the formulas were selected for the Detroit area since some assumption had to be made and the study was conducted for that area.

Annual cost in dollars per sq ft versus thickness of added insulation for a residential ceiling with mineral wool laid above the ceiling is shown in Fig 1.

The first curve, "construction cost," shows how the annual cost of insulation increases with insulation thickness. The construction cost includes both labor and material.

The second curve, "heating cost," shows the annual value of heat passing through the surface in an average heating season.

Third Curve Is Most Significant

The third curve, "total cost" is the sum of the first two curves and is the most significant. The dip, or minimum, in this curve occurs at the insulation thickness corresponding to the minimum total annual cost and is the optimum insulation thickness; in this case, 8.0 in. This is more, than is generally used in residential ceilings. The over-all heat transfer coefficient for this ceiling is only 0.032.

The curves in Fig 2 were plotted in the same way for a residential frame wall of common construction. Mineral wool batts are used for insulation. Here, the optimum insulation thickness is 5.7 in. The fact that there is only 3⅝ in. of wall

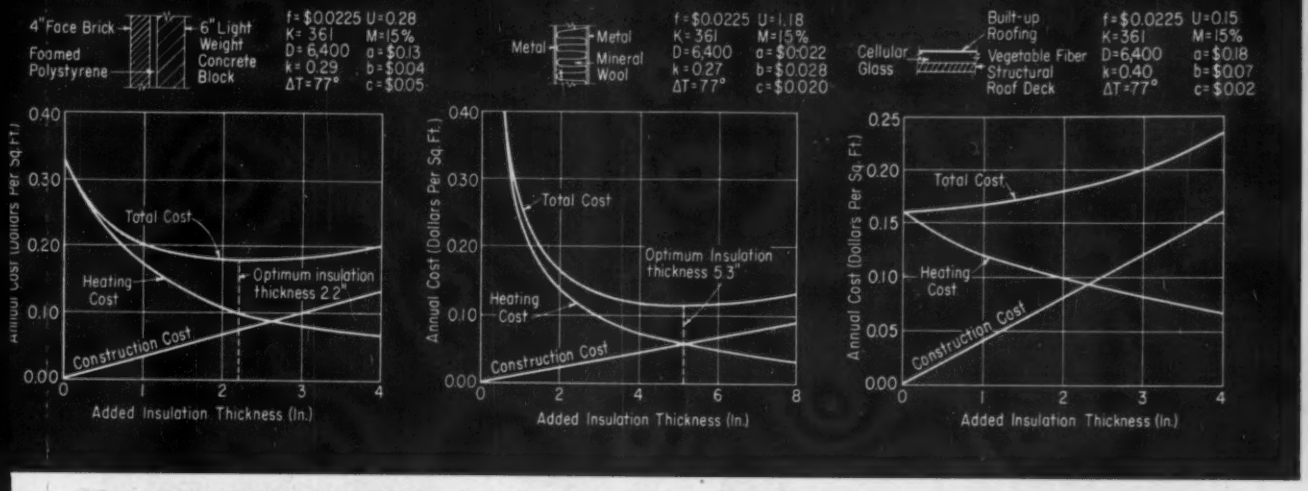


FIG 4—COMMERCIAL - INDUSTRIAL masonry cavity wall optimum added insulation thickness is 2.2 in.

FIG 5—COMMERCIAL - INDUSTRIAL curtain wall optimum added insulation thickness is 5.3 in.

FIG 6—NO ADDED insulation is justified with the commercial-industrial rigid-roof type

Heating Varies With Climatic Conditions

space available is not overlooked but more than 3⅝ in. of insulation is economically justified.

It is suggested that under certain conditions 2 in. x 6 in. studding is justified instead of 2 x 4 in. for electric heating just to provide room for the insulation. This construction is actually being used in certain areas. If the 2 x 6 in. studs are placed on 24 in. centers instead of 16 in., the building would cost very little more.

Fig 3 is similar to the curves in Fig 1 and 2 except that it is for overhead in an unheated residential basement. Mineral wool is supported by wires attached to the underside of the floor joists. The curves show that the optimum thickness is 1.7 in., so the 2 in. standard is satisfactory for the conditions stated.

These calculations would not apply to the case of a vented crawl space. More insulation would be required because the crawl space temperature would be nearly equal to the outdoor temperature.

Optimum insulation for a commercial-industrial type of construction, a masonry cavity wall with foamed polystrene in the cavity as shown in Fig 4 is only 2.2 in. This is less than the optimum insulation for the residential wall example for two principal reasons:

1. The insulating material is more expensive.

2. The cost of money for a commercial-industrial establishment is higher than for a private owner.

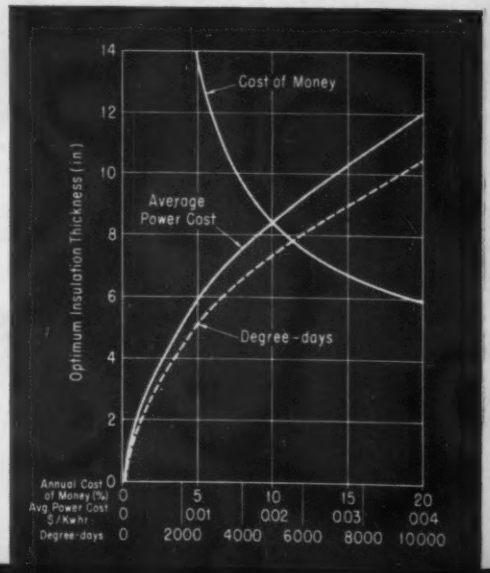
Foamed polystrene is advantageous in this application because of its effectiveness in reducing moisture migration. But it is not the only material which could be used.

For another commercial-industrial type of construction which is becoming increasingly important the optimum insulation thickness curves are shown in Fig 5. Insulation is mineral wool. Optimum thickness is 5.3 in. However, it should be noted that this insulating material and such insulation thicknesses are not generally used in this type of wall.

Considering a commercial industrial rigid-type roof insulation over a vegetable fiber structural roof deck on a building without a ceiling it may be found that no insulation is justified. This is shown by the curves in Fig 6. The calculations were based upon a cellular glass type of insulation but the same conclusion would be possible with other rigid-roof insulation.

Mineral wool blankets supported below the roof would be more economical than rigid-roof insulation under these conditions. Rigid-roof insulations are in general more costly than mineral wool. In many cases, in the absence of a ceiling, it

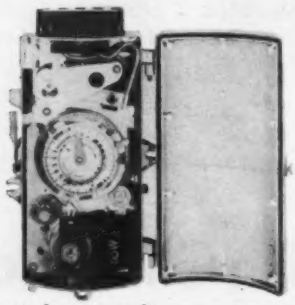
FIG 7—OPTIMUM INSULATION thickness varies with money cost, average power cost and number of degree days



"CLEAN AS A HOUND'S TOOTH?"

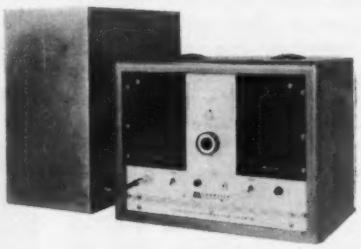
NO...

CLEAN AS A TIME SWITCH



Perhaps astronomic time switches won't ever become as popular a symbol for cleanliness, but after 90 seconds in an Acoustica Ultrasonic Unit they're *better* than "hound's-tooth clean"... *without even being disassembled.* New York City, for example, has 250,000 such switches to turn its street lights on at sunset, off at sunrise. Formerly, when airborne dust and soot clogged a switch's precision gears, it had to be torn down into 50 separate pieces, hand cleaned, and re-assembled... 30 minutes or more per switch. Now, the complete switch is placed in an Acoustica Ultrasonic Unit and in *just 1/20th of the time* is completely clean, ready for lubrication, re-installation and another three to five years of dependable service.

More and more municipalities, utilities and industries are finding Acoustica Ultrasonic Units, such as this Model DR500AH, the most direct route to increased cleaning efficiency, decreased cleaning costs in servicing meters, valves, switches and similar precision equipment.



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(*Continued from page 95*)

is economical to provide a special suspension just to support the insulation.

In order to determine optimum insulation thickness directly and quickly a mathematical equation has been developed, based on the Strock fuel consumption equation. The curves of accompanying figures were plotted from this equation. A simpler form of the general equation, adapted for electric heating, is as follows:

$$T = \frac{fDk}{142M\,(a + b + c)} - \frac{k}{U} \text{ where}$$

T = optimum added insulation thickness (inches)

f = average electric rate (¢ per kwhr)

D = degree days

k = thermal conductivity of insulation

M = annual investment cost (%)

a = insulation material cost ($/board ft)

b = insulation labor cost ($/board ft)

c = added building cost, if any, for insulation ($/board ft of insulation)

U = over-all heat transmission coefficient of surface without added insulation.

The general equation accurately and mathematically finds the insulation thickness corresponding to minimum total cost; i.e. the bottom of the dip in the cost curve.

Typical values of "M," as used for the accompanying curves, are: Schools, 8% per year; churches, 9%; residential owner, 10%; commercial and industrial, 15%.

In using these equations, work is not directed toward any preconceived final comined "U" values. The "U's" will vary depending upon the terms of the equation.

The equations may be used to show how optimum insulation thickness changes when some of the factors change. The results are shown in Fig 7 for the same residential ceiling in the example in Fig 1. In Fig 1 the optimum thickness of mineral wool insulation was 8 in. Each of the three curves in Fig 8 was developed by holding everything constant except the variable under consideration. These curves show the variation in optimum insulation with variations in the dif-

ferent factors and the necessity of avoiding over simplification, particularly to the extent of adopting nation-wide standards of insulation thickness.

These curves do show that optimum insulation thickness can be calculated for any set of conditions but that each electric power company must make the calculations for its own climatic and other conditions.

Underground Wiring to Be Encouraged in Hawaii

Hawaiian Electric Co is going to do all it can to encourage installation of underground wiring in future subdivisions.

Steps planned include:

1. Paying the full cost (about $50) of property line-to-meter underground installation in Gold Medallion homes and half cost in Bronze Medallion homes.

2. Absorbing the extra maintenance and operation costs of underground wiring when installed.

3. Working with the FHA and lending institutions to obtain increased appraisals (of approximately $500) for loan purposes on homes in underground areas.

4. Working with other utilities to reduce overhead wiring, and consolidating electric wires with street lighting wires. The consolidation has reduced the cost of street lights from about $1,500 to $1,700 per unit to about $700.

Hawaiian Electric President Ralph B. Johnson believes underground wiring is important to preserve Hawaii's natural beauty and has persuaded subdividers that it can pay off economically as well.

The two biggest subdivisions now planned, each with more than 10,000 units, will have underground wires.

For existing areas, Johnson suggested efforts to reduce the number of wires and the hiding of wires by trees where it is not feasible to shift to underground.

According to Rudolph Peterson, president of the Bank of Hawaii, "In the long run, the amount the home owner puts in for underground wiring will double in value, particularly for view lots."

CONVERTING?

Use General Electric replacement parts in your transformer rebuilding program

Utilize your old or obsolete distribution transformers by rebuilding with General Electric's complete line of renewal parts. You can rebuild to match converted-system voltages, increased kva ratings and change transformers from conventional to self-protected units quickly and economically.

When distribution system voltages are increased you can uprate from 2400 to 7200 or 7620 volts (for example) and take advantage of modern voltages with minimum expense for transformer rebuilding. Moreover, an old 5-kva, low-voltage unit can now typically be uprated to 16.8 kva by utilizing a Permalex* core and coil.

Protective devices—such as Magne-valve lightning arresters and circuit breakers—permit inexpensive modernization from conventional Type HS transformers to HSBA self-protected models.

Rebuilding can be done by one of the 55 General Electric Apparatus Service Shops or in your own repair shop. For complete details about modern distribution transformer rebuilding, see your G-E Sales Engineer or the Representative from your General Electric Service Shop. General Electric Co., Schenectady 5, New York. 485-04

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ECNE to Hold Program For Management Training

The Electric Council of New England will hold its first Management Training Program Oct. 2-8 at the Bald Peak Colony Club in Melvin Village, N.H. Sponsored by the Employee Relations Committee of the Council, the meeting is aimed at broadening understanding of the management function.

The program is designed to identify management skills and show how they apply to the individual utility manager's job, and to emphasize the importance of human relations skills and their effective use.

It will combine lectures by industry leaders and experts in the management field, small group discussions of the application of principles to concrete situations, and evening sessions on related phases of utility management.

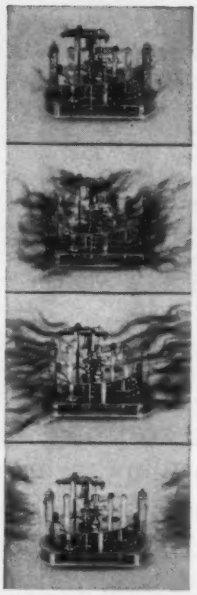
Among the speakers will be Sherman R. Knapp, president of Connecticut Light & Power Co and Edison Electric Institute; Edwin Vennard, managing director of Edison Electric Institute; Edward N. Gadsby, chairman of the Securities & Exchange Commission; Lawrence M. Kearns, partner in Morgan, Brown & Kearns; and Francis F. Bradshaw, chairman of the board of Richardson, Bellows & Henry Co.

There will also be speakers from the faculties of Cornell University, New York University, Duquesne University, College of the City of New York, and the University of Connecticut.

The program is aimed at middle management personnel—those in the area from the second level of supervision upward to, but not including, the officer level.

Registration is limited to 45, to provide maximum individual participation. No more than five registrants will be accepted from any one company.

The registration fee, $250 per person, covers room, board, tuition, and supplies. It should be mailed no later than Sept. 15 to: Eliot Priest, Public Service Co of New Hampshire, Manchester, N. H. Checks are to be made payable to the "Electric Council of New England."



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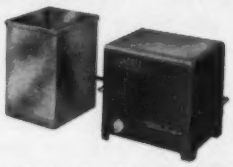

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The self-tuning Autosonic . . . gives you cleaner units every time even with an unskilled operator . . . saves labor and material costs . . . makes your maintenance and salvage programs really pay off.

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Letters

(*Continued from page 5*)

power companies would direct E. Hofer and Sons and the ECAP program toward selling electricity, the one area in which electric co-ops and the power companies ought to be working together for the mutual benefit of both, instead of using false, and at best distorted information to gain a total monopoly in the electric utility business. A second and necessary step to mutual trust and cooperation would be for the commercial power companies to give the co-ops reliable service at reasonable rates, not the power company's version of "what the co-op customers can reasonably afford to pay," as you stated in your editorial.

Just for instance, our power supplier conducts an active campaign of typical ECAP propaganda to its employees, with specific reference to REA co-ops. At the same time charging us, its largest customer, nearly 13 mills a kwhr for wholesale power. For comparison, nearby Virginia electric co-ops pay about half as much for their power requirements—their low rate brought about by access to hydroelectric power from the Roanoke River and a threat of building their own generation and transmission. We shouldn't have to spend thousands of dollars to bring about a reasonable rate, and be abused by our supplier at the same time.

John W. Asher Jr, executive asst
Choptank Electric Cooperative, Inc
Denton, Md.

BPA Tests Conductors

The Bonneville Power Administration is currently purchasing 4,000-ft sample lengths of 2.15-in.-dia transmission conductor of several expanded designs for installation on a line designed for 345 kv. These sample conductors are being furnished by four or five different manufacturers. Special splice fittings and dead-end fittings are being developed for use with the conductors. Electrical tests will be made on the fittings.

BPA also disclosed that electrical laboratory tests would also be conducted on hardware and fittings, as well as conductor, to determine their suitability for operation at 460 kv. Conductor creep studies will be made so that plans can be made for stringing these conductors.

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USS Tiger Brand Paper-Lead Cable

Like most utilities, Consolidated Edison of New York City, is engaged in an endless race to keep up with the growing demand for electric power.

In the Williamsburg section of Brooklyn, new USS Tiger Brand Paper-Lead Cables were installed to replace some of the existing ones that were being removed, due to system rearrangement, after 20 years or more of service. In some areas, the new cables were an addition rather than a replacement. The old cables were still giving good service but additional capacity was needed.

USS Tiger Brand paper-insulated, lead-sheath cables are noted for their reliability. More than 56,000 feet were used by Consolidated Edison in recent expansion programs. Engineering specifications called for 2/0, 27 KV, 3-conductor cable in carefully predetermined lengths for the Williamsburg section.

For high-voltage feeders, USS Tiger Brand Paper Insulated Cable is available in solid or gas-filled types. Many special constructions are available as standard production. An inquiry detailing your requirements will receive our prompt and careful attention. Write American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio.

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Power boost for Williamsburg area. Crew makes a 393-foot pull applying lubrication on the new Tiger Brand Cable as it is fed into the underground duct.

MacDonald Made President of Potomac Edison

R. G. MacDonald has been elected president of Potomac Edison Co. He succeeds D. E. Stultz who resigned due to ill health.

MacDonald had been vice president-marketing of the West Penn Power Co since 1925. Both West Penn Power and Potomac Edison are members of the West Penn Electric System.

An electrical engineering graduate of the University of Pittsburgh, MacDonald had been with West Penn Power for over 29 years. After some years in lines and construction work, he became district manager. He was later named division manager, then assistant vice president. Before his promotion to VP-marketing he was manager of general services.

He was most recently chairman of the Edison Electric Institute Sales Division Executive Committee.

Sylvania Makes Connor Senior VP

Sylvania Electric Products Inc has named George C. Connor a senior vice president with responsibility for the company's marketing activities.

Connor had been regional sales vice president in the East for the past year. Before that he was vice president-photolamp sales of Sylvania's Lighting Products Division.

A member of the Sylvania organization since 1934, he served in various engineering and marketing capacities before becoming general sales manager of the Electronics Division in 1946. He was appointed general sales manager-photolamps in 1951, and seven years later was named vice president-photolamp sales.

Before joining Sylvania he was with the Radio Corp of America, Brunswick-Balke-Collender Co, and Electronic Radio Corp.

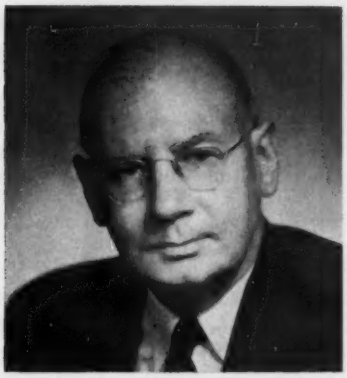
Baker Appointed VP-Manufacturing of American Brass

Robert S. Baker has been appointed vice president-manufacturing of the American Brass Co. Director of mill operations since 1952, Baker succeeds Sydney H. Wardell who retired.

Baker joined American Brass in 1925 as a trainee in the company's laboratory. In 1935, he was appointed service engineer at the company's headquarters in Waterbury, and in 1939 he was appointed technical supervisor to the Torrington Division.

He became assistant works manager of the Torrington Division in 1946 and its works manager in 1948.

Four years later Baker returned to the company's headquarters as director of mill operations. In this position, he supervised production of all the company's mills.



Lawrence Named EEI Sales Division Head

Claude D. Lawrence, vice president, New England Electric System, has been appointed chairman of the Edison Electric Institute Sales Division Executive Committee for 1960-61. He succeeds R. G. MacDonald who has become president of Potomac Edison Co.

Lawrence will preside over the 56-member committee which directs the activities of the other 18 committees of the Sales Division.

He joined the New England Power Service Co in 1929, was made head of the company's industrial and commercial departments in 1934, and ten years later was appointed vice president in charge of sales, the post he now holds.

Piore Elected IBM Vice President

Dr Emanuel R. Piore has been elected vice president for research and engineering for International Business Machines Corp. He will continue as director of research, and

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The Balanced Design of Delta-Star "Crystal Valve" Lightning Arresters gives extra protection and increases arrester life. The valve element controls, as it should, the follow current for interruption by the gap, and also provides conductivity for impulse and resistance for seal-off. The electrical characteristics of the special granular form of the unbonded oxidized silicon carbide, called Crystallite®, properly supplements the other design characteristics of the arrester to give a truly balanced design.

For full information on Delta-Star "Crystal Valve" Arresters write to ..... *Delta-Star Electric Division, H. K. Porter Company, Inc., 2437-W. Fulton Street, Chicago 12, Illinois.*

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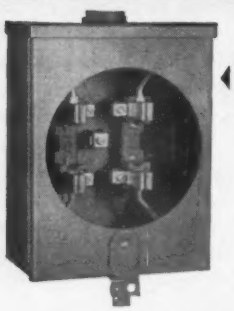
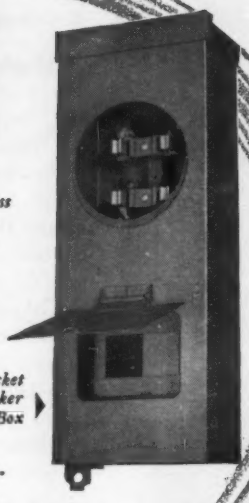


Ringless Meter Socket



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in his new position will exercise staff supervision over the research and engineering activities.

Piore joined IBM in 1956. Before that he was vice president in charge of research for the Avco Manufacturing Co.

PERSONAL BRIEFS

W. B. Willsey has become assistant chief chemist for Philadelphia Electric Co.

Thomas E. Marburger, vice president, engineering and construction, Baltimore Gas & Electric Co, has succeeded **A. L. Penniman Jr,** retired, as a member of the board of directors of Atomic Power Development Associates, Inc.

Julius Daniels, assistant to the general sales manager, has retired from Boston Edison Co.

Allen M. Herrmann has become manager of Southern Berkshire Power & Electric Co, New England Electric System. **Howard E. Stockwell** has been named assistant operating engineer of NEES.

The following promotions have been made in the meter & test department of Consolidated Edison Co of New York, Inc: **A. K. Joecks,** associate manager of the department; **F. L. Williams,** chief test engineer in charge of the test bureau; **O. S. Stamm,** outside plant test engineer; **W. L. Crosby,** inside plant engineer; and **E. A. Blomqvist,** general test engineer.

Charles L. Hazlett has become industrial power sales engineer in Northern Indiana Public Service Co's Hammond district.

Nicholas Roomy has joined Appalachian Power Co's division staff in charge of heating sales activities, residential field, Huntington, Logan, and Williamson districts. Also: **Woodrow Holbrook** took charge of appliance sales, dealer activities, and the home service program in the three districts; **Lawson Bailey,** in the division commercial department, has assumed duties as coordinator of commercial and industrial sales activities in the three

districts; **G. H. Burns** has become coordinator, in the division commercial department, of service on appliances, the electric heat pump and electric home heating with dealers and distributors in the division.

John J. Farrell has retired as operating engineer at El Paso Electric Co's Rio Grande plant.

Northern States Power Co has appointed **Raymond A. Byrnes** manager of the Southwestern Division.

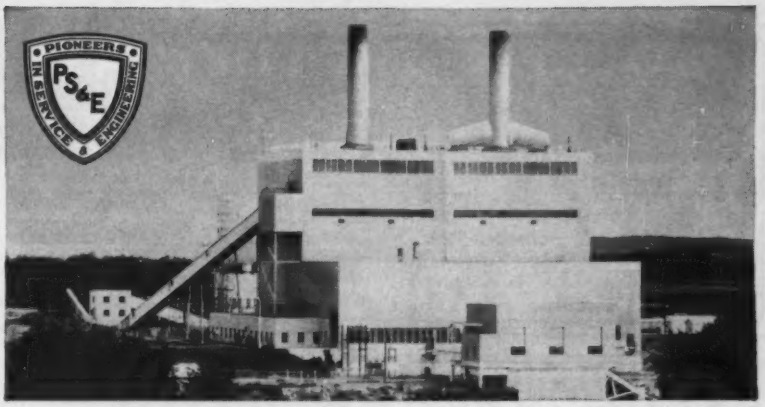
New chief accountant at Northern Berkshire Electric Co is **Arthur E. Messier.**

E. Allen Hunter has become assistant to the president of Utah Power & Light Co.

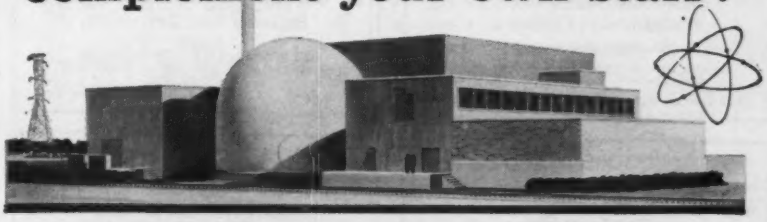
Harvey McPhail has been appointed executive director, Colorado River Basin Power Consumers Assn, Inc.

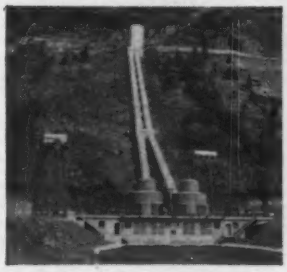
W. W. Quistorff has succeeded **J. Harvey Leach** as Western Division manager of the Puget Sound Power & Light Co.

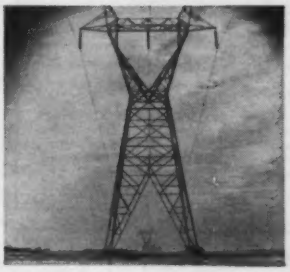
Thirteen members of the American Institute of Electrical Engineers have been promoted to the grade of Fellow: **Marvin Baker,** General Electric Co manager of product engineering; **Frank M. Clark,** GE consulting engineer-insulation; **Walter J. Creamer,** electrical engineering department head, University of Maine; **Walter Criley,** electrical engineering professor at Vanderbilt University; **Hilding F. Gidlund,** electrical distribution department superintendent, Public Service Co of Colorado; **Gerhart W. Heumann,** senior engineer on power utilization problems, GE; **Ray D. Jones,** liaison engineer, Ft. Wayne Laboratory, GE; **Marvin Lee,** president, Burndy Corp; **Marion R. Lory,** engineering manager, large rotating apparatus department, Westinghouse Electric Corp; **Fred W. McCloska,** nuclear department head, Sargent & Lundy Engineers; **Irvine E. Ross,** manager, engineering, specialty motor department, GE; **Gareth G. Somerville,** manager, Process Development Laboratory, distribution transformer department, GE; and **Charles R. Vail,** professor and chairman, electrical engineering department, Duke University.



Which Pioneer service do you need to complement your own staff?







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Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

SERVICES IN REGULATORY MATTERS

Pioneer offers its services in all phases of Federal, State and local utility regulation, including natural gas and electric rate matters, certificate proceedings, licensed project accounting requirements, depreciation studies for rate case and income tax purposes, cost allocations and special studies.

CORPORATE SERVICES

Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

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1	12000	G. E.	115,000—46,000 L. T. C.
1	5000	West.	115,000—13,750, 3 Ph.
1	10000	West.	67,000—34,500, 3 Ph. Auto.
1	3750	G. E.	69,300—13,200, 3 Ph.
1	3000	G. E.	69,000—4340, 3 Ph.
4	2000	Amer.	67,650—22,000
3	1250	G. E.	69,300—2400/4160
3	500	G. E.	66,000/33,000—2300/13200
1	2500	Mol.	44,000—2400/4160, 3 Ph.
2	2500	Wagner	45,800/22,900—4160Y, 3 Ph.
1	5000	West.	34,500—13750/6875, 3 Ph.
1	4500	West.	33,000—2500/4330, 3 Ph.
2	3000	Upef.	34,750—4160, 3 Ph.
1	2000	Kuhl.	34,650—440, 3 Ph.
2	1500	G. E.	34,400—2520, 3 Ph.
3	1250	A. C.	33,000—480
1	500	Mol.	34,500—2300/4600
3	200	A. C.	34,500—2400/7200/12470Y
2	3000	G. E.	26,400—4160Y/2400, 3 Ph.
3	1250	G. E.	29,340—2500
2	3000	G. E.	13,800—2640, 3 Ph.
1	2500	G. E.	13,800—2400, Unit Sub.
1	600	Stand.	13,200—2300, 3 Ph.
3	500	G. E.	13,200—240 x 480
1	450	Penna.	13,200—2400, 3 Ph. Askarel
3	333	G. E.	13,800—230/460
3	100	A. C.	6,900—2400
1	500	Kuhl.	4,800—480, 3 Ph.
1	1000	A. C.	2,400/4,160—240, 3 Ph.
3	400	G. E.	2,300/4,000—230/460

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1	1500 Kw, 60 cycle, 2300 volts, Generator 2100 Hp, 25 cycle, 2300 volts, Motor—300 Rpm
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4—1000 KVA Mol 7200/12470Y—4160
3—1000 KVA G-E 34500-7200/12470Y
6— 500 KVA G-E 34500-2400/4160Y
3— 500 KVA Penn. 13200-120/240
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA GE 66000—2400/4160Y
3— 333 KVA Wag. 2400—120/240
2—1500/1875 KVA Mol. 3-Ph. 40,500—4800 F/C equipped
2—1500/1875 KVA Mol. 3-Ph. 34,500—2400 F/C equipped
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The Meetings Calendar

SEPTEMBER

Edison Electric Institute—Meter & Service Committee, Westchester Country Club, Rye, N. Y., Sept. 18-21; Residential Electric Heating & Air Conditioning Committee, New York City, Sept. 19-20; Commercial Electric Space Heating & Air Conditioning Committee, Columbus, Sept. 20-21; Industrial Power & Heating Group, Milwaukee, Sept. 21-23; Residential Wiring Promotion Committee, Salem, Mass., Sept. 22-23; Farm Group Meeting, New York City, Sept. 26-27; Commercial Lighting Committee, Birmingham, Sept. 26-27; Residential Appliance Promotion Committee, New York City, Sept. 26-27; Industrial Relations Committee, 13th Annual Round Table Conference, Drake Hotel, Chicago, Sept. 26-28; Market Research Committee, Detroit, Sept. 27-28; Home Service Committee, Fort Worth, Sept. 29-30; Commercial Cooking Committee, Akron, Sept. 29-30.

Pennsylvania Electric Association — Annual Meeting, Penn Sheraton Hotel, Pittsburgh, Sept. 21-22.

Industrial Electronics Symposium—Manger Hotel, Cleveland, Sept. 21-22.

Inter-Industry Farm Electric Utilization Council—7th Annual National Electric Farm Power Conference, Kentucky Hotel, Louisville, Sept. 21-23.

National Power Conference—Sponsored by American Institute of Electrical Engineers and American Society of Mechanical Engineers, Bellevue-Strafford Hotel, Philadelphia, Sept. 21-23.

Missouri Valley Electric Association—Accounting Conference, President Hotel, Kansas City, Sept. 22-23.

Tennessee Valley Public Power Association—Annual Meeting Power Use Section, Noel Hotel, Nashville, Tennessee, Sept. 26-27.

International Association of Electrical Inspectors—Eastern Section, Wentworth-by-the-Sea, Portsmouth, N. H., Sept. 26-28.

• **Instrument Society of America**—Fall Instrument-Automation Conference & Exhibit and 15th Annual Meeting, New York Coliseum, New York City, Sept. 26-30.

• **Canadian Electrical Manufacturers Association**—16th Annual Meeting, Sheraton Brock Hotel, Niagara Falls, Canada, Sept. 28-30.

• **Indiana Electric Association**—Annual Convention, French Lick-Sheraton Hotel, French-Lick, Ind., Sept. 28-30.

Northwest Public Power Association—Power Use Section, Annual Meeting, Hotel Monticello, Longview, Wash., Sept. 29-30.

• **Electric Companies Public Information Program**—PIP Workshop Conference, Sheraton-Charles Hotel, New Orleans, Sept. 29-30.

Southeastern Electric Exchange—Accounting Conference, Tides Hotel, St. Petersburg, Sept. 29-30.

OCTOBER

• **Interstate Power Club**—Beverly Hotel, New York City, Oct. 3.

• **Edison Electric Institute**—Prime Movers Committee, Benjamin Franklin Hotel, Philadelphia, Oct. 3-5; Transmission & Distribution Committee, Sheraton Jefferson Hotel, St. Louis, Oct. 6-7; Power Survey Committee, EEI Headquarters, Oct. 6; Advertising Committee, New York City, Oct. 13-14; Electrical Systems & Equipment Committee, Hotel Northampton, Northampton, Mass., Oct. 17-18; Sales Division Executive Committee, New York City, Oct. 18-19; EEI Statistical Committee, The Homestead, Hot Springs, Oct. 27-28.

• **Institute of Radio Engineers**—Seventh Annual Meeting of the Professional Group on Nuclear Science, Sponsored jointly by PGNS and Oak Ridge National Laboratory, Gatlinburg, Tenn., Oct. 3-5.

• Additions this week.

Electrical World's Second Street and Highway Lighting Conference — Hotels Ambassador, Chicago, Ill., Oct. 19-20.

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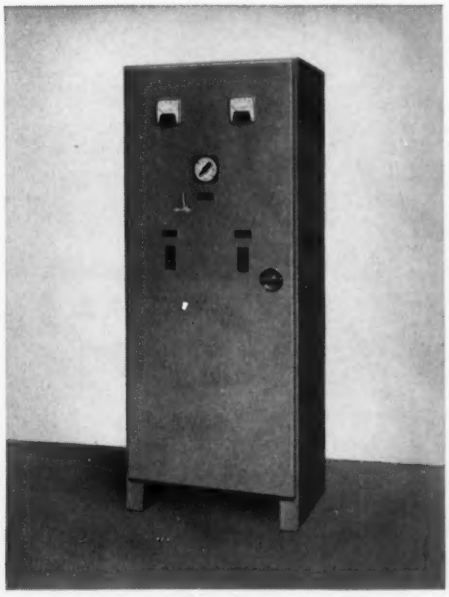

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